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INVENTORY OF U.S. AIR POWER

FEB. 28, 1949

WEEK

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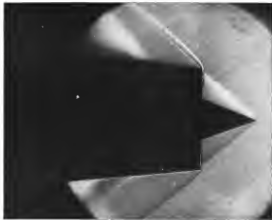
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A small-scale model of a true jet inlet is mounted in Wright's supersonic wind tunnel. As the air flows at mach No. 2 it sweeps the speed of sound through the tunnel, achieves optimum—an optical instrument—accurately photographs the influence of the jet's body lines upon the flow pattern of the air. The oblique lines in picture represent shock waves caused by impact of body on air.

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POWER FOR AIR PROGRESS

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AVIATION WEEK, February 28, 1949

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AVIATION WEEK

Vol. 38, No. 9

February 25, 1949

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Inventory of U. S. Air Power

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NEWS DIGEST

DOMESTIC

Merge talks reportedly have taken place between Tervian International Airlines and TWA, but Daniel R. A. Wilbur, president of TWA, claims "the deal... has been closed with anybody." Wilbur succeeded Lt. Gen. Harold Grogg (Ret.) as head of the Providence firm. Grogg is now vice president and general manager of Hughes Aircraft Co.

Fisher-Clark Corp. has been forced, through security facilities of Frederic Fisher, Inc., North Tonawanda, N. Y., and Clark Bros. Co., Inc., Olney, N. Y., a division of Dress Industries, Cleveland. New firm will apply to industrial facilities and flow computer principles developed in aircraft gas turbines.

Walter F. Schuss, former executive plane pilot, has been appointed Florida aviation supervisor, succeeding William Luzzini, who resigned without announcing his future plans.

Boeing Aircraft Co. delivered its annual Statement to the American Airway, and announced two are being studied for delivery by Mar. 5.

Aircraft Maintenance Corp.'s USAF contract covering remodeling of 47 C-47s has been extended to include 16 additional aircraft. Basic work is being done at ANAC's Van Nuys, Calif., service center.

FINANCIAL

Panair Air Lines reports net profit of \$119,532 for its 1948 operations, making an overall profit of \$8900 for 48 months of operation.

TWA has filed a registration statement with SEC, offering 404,112 shares of common stock to stockholders at the rate of \$10 per common share for each five shares held. Hughes Tool Co., holder of 1,484,533 shares, has agreed to purchase 287,524 shares of the total offering.

FOREIGN

F. A. Conner, chief of ICARO's administrative bureau, announced his resignation effective July 1. Member states of ICARO are being asked to submit accounts for his successor.

BOMC contract with Canadian for 22 four-engine, 40 passenger planes, presently Canadian Pacific, will be for \$17 million. Canadian's contract with Canadian Pacific Airlines is for \$5 million, to supply three of the 36-passenger four-engine transports.

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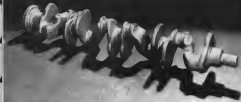
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AVIATION WEEK

THE SECRETARY OF DEFENSE
WASHINGTON

THE ROLE OF U.S. AIR POWER

Air power has become one of the great instruments of military strength. In our own country that power has to be viewed not merely in terms of the Air Force alone or of Naval Aviation alone, but in terms of the total air power of the United States. That this power has now reached maturity and is aware of its relationship to other forces is amply evidenced by the fact that the military heads of our services are in unanimous agreement that the security of our nation depends upon a proper combination and employment of land, sea and air teams.

As for the future, no man can predict with accuracy the exact specifications for security, but whatever they may be, air power will be required.

Whatever may be the evolution of military power of the future, the best guarantee for universal peace is to have the most potent force in the hands of the most peaceful nation. To that end, and with no unbalance of economy, this nation must strive.

James Forrestal

THIS is Aviation Week's second Inventory of U. S. Air Power, the 16th successive Yearbook.

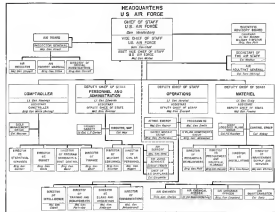
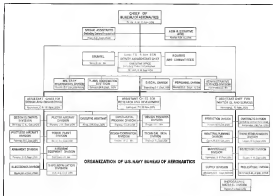
As Secretary of Defense James Forrestal points out in the above statement which he wrote especially for this issue of Aviation Week, air power is the total air resources of the United States.

The job of strengthening these resources begins first

at home with the biggest peacetime aviation appropriations in our history. This is a progress report.

But to judge the effectiveness of the U. S. air power, the air potential of other countries must be examined. Accordingly, McGraw-Hill World News correspondents report on aircraft and air power of principal foreign nations.

AIR DEFENSE



Air Power: America's First Line of Defense

With manufacturing reviving and service differences dwindling, U. S. air power prepares for world role.

By Robert Hott

Airpower for power is emerging as the most significant force in the postwar world.

Defense Secretary James V. Forrestal has indicated that within five years America's air power may assume the role that was played by British sea power during the last century. Some observers believe that Forrestal's estimate may be conservative in its time element.

► **Air Power First**—There is no longer much opposition to the thesis that air power has replaced sea power as America's first line of defense. Elsewhere than there is implemented with the desire to provide an adequate force capable of playing the role will depend fast, on Congressional action in providing the funds required for the development and

production of adequate air power. Second, on the ability of the military to produce the planes necessary, and third, on the skill of the military service in applying this equipment to the specific tactical and strategic problems confronting us as a nation.

There has been little change in the combat strength of U. S. air power during the past year. Total combat planes in operation numbered 11,501 as of Jan. 1, 1949, compared with 11,501 a year ago. Of these, 6800 are Navy planes and 5500 belong to USAF. In addition there is a combat plane reserve of 7183 planes (2181 Navy and 5000 USAF) with a support force of 36,514 bombers, transports and utility types. This makes total U. S. military air power number 15,697 planes (14,600 USAF and 11,497 Navy).

Technical Progress—Real progress has been made however in substituting the industrial line which produces the planes required and an equivalent built USAF and Navy, beginning with modern power types. Total of 2400 military planes with an average weight of 25 million lbs were manufactured in 1948 compared with 2300 planes and 11,490,000 airframe lbs in 1947. Both USAF and Navy now have numerous jet fighter groups equipped with only a few years ago.

Best estimates available now indicate that the USAF will appear at a strength of 37 combat groups during 1949 against its estimate of 70 groups in the maximum peacetime defense requirement. Navy will have about 7000 planes compared with the 14,500 plane pool set for its peacetime operations.

► **Built to Air Force**—Recent trend toward Capital Industries that the bulk of the air power budget will be awarded to the U. S. Air Force with Naval Aviation

playing a subordinate role. As USAF continues its heavy emphasis on development of strategic air power there is some evidence that the Navy may specialize in developing the elements of tactical air power in addition to its primary responsibility for anti-submarine warfare.

There is also evidence that the old and sharp division between the services regarding their respective air elements may be changing in a new pattern that will view all of the elements available in terms of total air power. Mergers of transport services in the Military Air Transport Service, with both Air Force and Navy personnel working in a common air operation, is an example of how the view may be translated into practical terms. Similar applications in the field of carrier training and tactical air power may be toward common education.

While inter-service technical progress has pushed performance up to levels only dreamed of in the immediate post-war period there has not been any parallel progress in the tactical application of these performance gains. Considerable effort will be devoted along this line in the immediate future.

USAF Builds Intercontinental Force

Activation of B-36 groups, plus refueling techniques, increase striking range and cause shift in emphasis.

In its second year as an independent organization within the National Military Establishment, the U. S. Air Force is placing its principal emphasis in the exercise of strategic air power through the intercontinental bomber.

Biggest event of the year was organization of two full combat groups (16 squadrons of Boeing B-36 bombers) and the debut on the production line of the B-36A, the first fully-automated version of the aerospace intercontinental bomber to roll out at Convair's Ft. Worth assembly plant.

► **B-36 Refueling**—Of almost equal significance was the modification of six surplus Boeing B-29s as aerial tankers for air-to-air refueling and the incorporation of 61 B-29 tankers in tactical units of the Strategic Air Command. Use of the tankers will permit the Boeing B-36 bomber to be used as intercontinental operators in a subordinate of the B-36. A full intercontinental bomber type

Nared Air Strength

Combat types operational—USAF 6,800

Combat types operational—USN 1,151

Logistical support (USAF, USN, 1,151)

(includes logistics, overhead 280)

TOTAL 11,497

USAF Strength

Active combat types 1,150

Inactive combat types (storage) 5,080

Active utility types 7,150

Inactive utility types 9,080

TOTAL 14,460

As of Jan. 1, 1949



Convair F-106



Boeing B-57C Stratofighter



North American F-4



North American X-47



Douglas F-105D1 Strikefighter



McDonnell F-101 Voodoo



North American F-108

on the agreement of Congress and may have a prototype flying before the end of 1945. It will be capable of ranges comparable to the B-36 without refueling and at higher speeds.

► **Kenny vs. LeMay**—Much of the emphasis on the intercontinental bomber in current USAF activities can be traced to the shift of Gen. Curtis LeMay to replace Gen. George Kenney, in command of the Strategic Air Command. Kenney's plans were based on the development of a bomber capable of speeds around Mach 1 with a range of about 6,000 miles and striking advanced foreign bases from which to strike the enemy. LeMay is the champion of the intercontinental bomber that is now accounted by the B-36 and potentially will use altitude, bad weather and emergency speed bursts to evade enemy defenses.

Recent USAF decision to buy 39 more B-36s is addition to the 95 now on order is a reflection of the LeMay viewpoint. Congress has recently added USAF a project to acquire all of the 134 B-36 built or on order with few jet engines (and no external missiles) under such wing.

These jet engines, which would be used for emergency power on takeoff as for landing among defenses, are in addition to the six Pratt & Whitney T50s hp. Many Major power engines need for several reasons that now are detailed.

► **Striking Power**—Building on the firm operational foundation laid during Kenney's command of SAC, LeMay is building a mobile long range striking force capable of hitting targets almost anywhere in the world from North America. The relatively small numbers of the long range striking force can deliver the destructive weight of an attack that is merely required mass formations of more than a hundred times that present size.

Existence of this long range striking force is probably the most significant element of American air power today. While its capabilities to carry out its intended objectives may be severely questioned, no foreign power would gamble its own cities in a test of this capability without the most compelling motives.

► **Threats**—Curtis LeMay Strategic Air Command is rapidly approaching its full strength of 20 bomb groups plus strategic reconnaissance and defensive fighter groups, and is getting the lion's share of USAF money both in procurement and operations funds, based on power in language over by the most optimistic view Strategic Air Command is by Joint Chief of Staff staff, primary responsibility of USAF. This is the reason for the shift.

With a Presidential order out from

USAF Requirements for 70-Group Regular Air Force (plus 22 special squadrons)

| Plane Type | No. of Groups | Number of Planes |
|---|---------------|------------------|
| Heavy Bomber (B-36) | 4 | 95 |
| Strategic Bomber (B-36) | 1 | 40 |
| Medium Bomber (B-29, B-18, B-24) | 16 | 495 |
| Medium Bomber (B-18, B-24) | 1 | 158 |
| Light Bomber (B-41, B-47) | 1 | 435 |
| Fighters | | |
| Interceptor (F-80, F-84, F-86) | 22 | 3,800 |
| All Weather (F-81, F-90) | 1 | 131 |
| Tactical Recon (F-87) | 4 | 165 |
| Transports | | |
| Heavy (C-124) | 4 | 417 |
| Medium (C-119) | 8 | 461 |
| Light (C-115, C-112) | 2 | 116 |
| Amphibious (RA-10) | 1 | 37 |
| Landing (L-36, L-17) | 1 | 418 |
| Helicopters | | 104 |
| Trainers | | |
| Primary Trainer (T-33, T-38) | 1 | 1,181 |
| Advanced single engine (T-38) | 1 | 136 |
| Advanced twin-engine (T-38) | 1 | 906 |
| TOTAL Regular AF | 70 | 6,079 |
| Air Reserve (including reserve) | 14 | 2,580 |
| Air National Guard | 27 | 1,212 |
| TOTAL RESERVE AF | 41 | 3,792 |
| Storage Pool (to replace total combat losses) | | 8,100 |
| TOTAL PLANES REQUIRED | | 20,571 |

Service Plane Designations

The rapidly-changing mission and technology of the Air Force and Navy require more comprehensive changes in aircraft designations although the principle of both systems is the same.

► **Air Force**—The Air Force designates the mission, type and model number of its aircraft by the following letters: A, amphibious; C, cargo; F, fighter; H, helicopter; I, intercept; K, reconnaissance; L, land; M, medium; N, night; O, observation; P, transport; Q, transport; R, reconnaissance; S, scout; T, trainer; U, utility; V, variable; W, variable; X, experimental; Y, variable; Z, variable.

In addition, a large number of suffixes are used to indicate special modifications to otherwise standard aircraft types. A, amphibious; B, special; C, cargo; D, cargo; E, cargo; F, cargo; G, cargo; H, cargo; I, cargo; J, cargo; K, cargo; L, cargo; M, cargo; N, cargo; O, cargo; P, cargo; Q, cargo; R, cargo; S, cargo; T, cargo; U, cargo; V, cargo; W, cargo; X, cargo; Y, cargo; Z, cargo.

► **Navy**—The Navy designates its aircraft by the following letters: A, amphibious; B, amphibious; C, amphibious; D, amphibious; E, amphibious; F, amphibious; G, amphibious; H, amphibious; I, amphibious; J, amphibious; K, amphibious; L, amphibious; M, amphibious; N, amphibious; O, amphibious; P, amphibious; Q, amphibious; R, amphibious; S, amphibious; T, amphibious; U, amphibious; V, amphibious; W, amphibious; X, amphibious; Y, amphibious; Z, amphibious.

Navy considers these numbers and letters to indicate aircraft types and models by designating the first number in the model designation and the second number as designating the same model.

56 group strength to 95 groups it was not surprising that fiscal air power suffered more than the strategic arm and there are good reasons why this poverty may be cured. However, there is a growing concern, particularly from the Army, over the lack of substantial progress in the tactical field.

► **Jet Transition.** Transition of USAF fighter groups to jet-powered planes is running smoothly with 15 jet fighter groups now in operation and four National Guard groups now being equipped with jet fighters. Types currently in operation and on order include the Lockheed F-46 series, Republic F-84 series and the North American F-86A.

North American's B-45 first jet

bomber is the only light bomber currently in production. USAF has been buying the Navy's Douglas AD attack planes since it is possible to believe the attack force of its former jet-powered B-26 most bomber would be considered a light bomber in its present form but will be part of the Strategic Air Command's bomber force in its later versions.

Night fighters are still a big gap in the USAF arsenal with only the F-60 and F-82, both prime powered, in operation and no clearly satisfactory jet night fighters even in experimental models. Emphasis on development of a satisfactory night fighter will be evident during the coming year.

transition to jet-powered McDonnell F3H Phantom and Grumman F9F Panther but this will increase only speed and if anything reduce range slightly.

The XAF-1, with its combination of piston power for cruising augmented by jet thrust for high speed in the target area, will boost the range of Navy carrier aviation out to a 1200-mile radius from its carrier. Similarly, the XF7U-1 will boost Navy fighter speeds into the supersonic at altitude and make them even possible in the best land-based fighter now flying.

► **Third Step.** Third step will see the production of a carrier-based bomber that will be similar roughly in basic design, performance and weight to improved versions of the USAF's XB-47. This new Navy attack type is now in a design competition with notes from most of the major aircraft manufacturers.

The design finally selected for prototype construction will extend the Navy's aerial range to a 2000-mile circle from the carrier, which, the Navy believes, will include every significant land target in the world. Fighter development in this phase will be along the same lines of supersonic performance already evident in the basic design of the Chance Vought XF7U-1.

► **Ultimate Goal.** This is the Navy's ultimate goal with these planes operating from 65,000-ton flush deck supercarriers of which the USS *Enterprise* is the prototype. Where aerial development reaches this stage it is likely that even in phases are now speculated for a specific purpose to will the carrier be divided along functional lines. Long range operations will operate from the big supercarriers behind a fighter screen and escorts will operate from smaller and faster ships under new tactical developments.

Plans for a water-based naval air force to replace the current striking force are still in the early experimental stages. First prototypes are scheduled for flight testing during 1949. They will be Chance's F3H flying boat, carrying a new type long range tank, and the Chance Swift, a flying boat fighter.

► **Carrier Strength Cut.** Navy's current air strength will be reduced from about 3000 planes to 2000, or about half of the 14,383 plane strength that a Navy's long term goal. At compressed recruitment continues to favor the largest share of air power budget for the U. S. Air Force it is likely that Naval Aviation will continue to make developing advanced prototypes and service test quantities of aircraft to prove the practicability of its theories rather than embarking on any large scale production program of tactical types similar to the build-up to 73 modernized cavalry groups which was begun by the Air Force last year.



McDonnell F3D-1 Phantom



Grumman F9F Panther



Lockheed F-80 Shooting Star



Boeing B-53A



Republic F-46 Thunderbolt



Northrop XF8U-1 Scorpion



Boeing XB-47 Stratojet



Chance Vought XF7U-1 Corsair

Projected Naval Air Program (including reserves)

Combat

| | |
|------------------------------------|-------|
| Fighters (F4U, F8F, F2H, F7U) | 3,900 |
| Attack (AD-1, 2, 3, 4, AM-1, AJ-1) | 1,972 |
| Patrol land based (P2V, P4M) | 598 |
| Patrol carrier based (PB4M, P5F) | 194 |
| Patrol amphibious (PB4M-5A) | 65 |

TOTAL COMBAT 6,639

Noncombat

| | |
|--------------------------|-------|
| Transport (heavy) | 94 |
| Transport (medium) | 337 |
| Utility (single engine) | 129 |
| Utility (multi-engine) | 512 |
| Training (single engine) | 1,823 |
| Training (multi-engine) | 715 |
| Helicopters | 539 |

TOTAL NONCOMBAT 3,860

TOTAL OPERATING AIRCRAFT 10,499

Logistic support (pipeline overhaul, etc.) 3,857

TOTAL PLANES 14,476

New Navy Planes Hint New Tactics

Future carrier force to be built around high speed, far-ranging craft whose prototypes now are flying.

Naval Aviation made significant experimental strides in speed and range during 1946 while continuing its slow but steady transition from piston engine types of jet powered planes.

Most significant new model planes of the year were the North American XAF-1, a carrier-based attack bomber powered by two piston engines and one turbojet, and the Chance Vought XF7U-1, a twin jet engine fighter boasting low aspect ratio and sweepback wings. Both mark the beginning of a new kind of ship-based aviation that is

the Navy's long term goal. This goal is a fast, mobile carrier task force with planes operating in the transonic speed range and striking at targets up to 2000 miles from their hosting bases.

► **Patton Force.** Patton Force carrier aviation is capable of hitting targets at a maximum range of about 800 miles from the carrier. This force consists primarily of Douglas AD series and Marine AD series attack planes with Grumman F8F and Chance Vought F4U-5 fighters—all piston powered engines. Fighter types of this force are already in

Steps Toward All-Weather Flight

Development of electronic airways system capable of handling high density traffic is goal of two groups.

Base pattern for administration and technical development of a new electronic Federal airways system, capable of handling high density traffic in any weather, was organized during 1946. In addition to agreement on the basic principles and equipment of the all-weather airways system for the United States it is highly probable that the International Civil Aviation Organization will approve them as an international standard.

More technical pattern for the all-weather airways is the Radio Technical Commission for Aeronautics report of its Special Committee No. 11. Two groups, formerly organized during last year, will have the responsibility for modifying the improvements defined in SC11. They are the Navigation Committee of the Research and Development Board, and the Navigation Panel of the Air Coordinating Committee.

► **ANED Role**—These two groups submit their operational requirements to the Air Navigation Development Board where research and development is directed to produce specific equipment (most in need of special) requirements. RTCA contract to Hughes as an advisory group on specific technical problems. During the past year it drew up specifications for electronic measuring equipment that will make it possible for the new to meet set of research and data production within the next year.

Approximately \$65 million in Federal funds will be authorized during fiscal 1950 to carry out the all-weather program. This contrasts with about \$20 million authorized last year. The \$65 million will be divided as follows: \$40 million for Civil Aeronautics Administration equipment purchase; \$10 million to ANED for research and studies; \$15 for USAF and Navy equipment purchase.

► **Procurement Plan**—While ANED will control expenditures of the research and development funds the bulk of its work will still be done by private companies and laboratories, under ANED contracts.

Progress is divided into two phases—the interim program, which is designed to utilize equipment already in the development stage, and the target program which is based on equipment yet to be developed. During 1949, the first step were three dozen general use of elements in the interim system.

► **ILS Plan**—First component to go into general use was the VHF radio beam

landing system (ILS) which is now operational at 57 U. S. and airports. Next component, the cross-directional signal, is expected to become operational by summer, with over 420 cross-range stations now installed and more than 35 calibrated and commissioned for actual use.

Deliveries of airborne receivers to utilize the all-weather have already begun and are expected to be of sufficient quantity to permit general service use of the communications before the last weather season begins again next fall. Big advantage of the cross-range over the present low course low frequency range is that it operates on stationary VHF frequencies and gives much more precise course and position information than the LF range. Further improvement in transmitting accuracy will be necessary for its use in the later phases of the interim program when instrument course computers will be used.

► **Traffic Control Radio**—Third element of the interim system now in flight is search radar, to be used for air traffic control in the approach areas to airports handling heavy traffic. Experimental installations of this type have been operating for over a year at Washington, New York and Pittsburgh with good results. General Electric has recently awarded a CMA contract to build 21 sets of traffic control for use at each airport. Still needed for use with this type radar is an airborne radar beacon that will positively identify an individual aircraft in the ground radar scope.

Fourth element is distance measuring equipment which is covering the road of

its development stage and getting ready to go into production. Basic specifications for DME were drawn by RTCA and approved by both U. S. and British technical groups as an international standard.

► **Computer Progress**—The automatic course computer is still in the development stage. It is designed to permit straight line and curving courses that are not except at any one-way stations to be flown automatically. When computers reach a high enough degree of accuracy it may be possible to layout multiple line airways on the cross-range system.

Other elements of the interim system still in early research stages are the ground two control device, private line visual communications system, and the coded airborne radio beacon for positive identification and automatic transmission of altitude and position.

► **Test Needed**—One of the basic elements still running from the all-weather airways development plan is an adequate program for service testing new equipment before it is adopted as a standard and installed for general use. ANED has begun working along this line with its limited tests of the instrument course-range and DME but it is evident from the results of that series of tests that a more comprehensive test program along strictly technical lines is necessary to give the aviation-world people concerned with the program a product to measure equipment efficiency.

This would enable them to cut through the continued fog of excessive non-technical claims and "political" policies of the governmental agencies concerned to get a clear picture of what is going on in a program that will eventually mean expenditure of a billion dollars in Federal funds and many more millions by the industry and private pilots.

Guided Missiles In Production

After three years of research and experimental development, guided missiles are going into the final phases of production. Many agencies will continue to be in research and development for some time to come, with objectives shifted primarily to making missiles to be used in attacking military personnel have to maintain and launch missiles at various types.

Present plans for the military service indicate that approximately \$50 million will be spent on production of a few guided missile types during the next two years. Considerably more will be expended during the same period for continued missile research, and USAF is seeking authorization from Congress

to establish a \$30 million testing range to be used by all three services.

USAF now has some basic guided missile production contracts with air craft manufacturing firms. Basic policy of both USAF and Navy is to depend on the defense manufacturing industry for guided missile production, since basic requirements for both piloted and piloted planes are the same—light and strong construction of proper aerodynamic shapes. Increased missile production will mean more emphasis to a group of new firms specializing in missile propulsion and control methods, as well as the established military contractors in electronic equipment and powerplants.

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planes and military sales of better than \$5 billion during the next three years, according to the Bureau of the Budget.

The profit industry was facing a grim prospect in the spring of 1948. Lack of sufficient military orders meant that many production lines would have to shut down by early summer. Most, if not all, companies had exhausted all of their working capital, loss of skilled labor loomed and the disruption of their design engineering teams. Production experts estimated that once all available military orders were forthcoming in the fiscal 1949 budget they would come to less than half their 1946 level and it would take the industry more than a year to recover from the effects.

• **Click Averted**—To avert this, annual procurement funds of the fiscal 1949 budget were rushed through Congress as a fiscal 1948 supplemental appropriation bill so that they would be available for expenditure in the spring of 1948 instead of early fall as was normal procedure.

Congress added some \$532 million to the President's aircraft procurement budget that gave the industry ongoing authorization to build 9624 planes. U.S. Air Force mailed letters of intent to successful contractors by early summer. With these letters of intent, firms could get new financing and were able to keep their production lines going. These orders also stimulated the first expenses of the industry from its postwar low.

• **New Plants**—During 1948, seven wartime facilities were returned to active production. These include the Boeing Wichita plant now producing B-29s and B-50s and tooling up for B-47 production; the General Electric plant at Lakeland, Ohio, now rolling out J-47 jet engines; the old Ford & Whittaker plant at Omaha now being tooling for Westinghouse jet engine production; and another General Electric facility devoted to electronic instruments.

Both USAF and Navy organized their steady plant program to provide government-owned production facilities for swift initial expansion of the aircraft industry to meet an emergency.

• **Employment Rise**—Employment rose steadily from 160,000 to 127,000 workers and is still climbing. Shortages of skilled personnel continue in some categories, particularly among engineers and technicians.

With the exception of a few well established production lines such as the Lockheed F-80 series, the Republic F-84 and Boeing's B-50 line, all of which enjoyed extended operations as a result of the expanded military air power program, the industry is still in the production tooling phase of the overall program. None of the new types such as the B-54, B-57 and B-59

U.S. Gas Turbine Engines

[illegible]

U. S. Propeller Manufacturers

| Manufacturer | Classification | Pitch Adjustment | HP Range | Price Range | Main Data | | | MILITARY PHOTOS |
|--|------------------------|---------------------|----------|----------------|-----------|-------------|--------------|--|
| | | | | | HP | Material | Construction | |
| Aircraft Aircraft Propellers Excess Co. Inc. Metal Products Div. Baltimore, Md. | 1A, 1T | Fixed | 50-200 | \$200 | 3 to 4 | 50" to 100" | Wt. | |
| Aircraft Aircraft Propellers Excess Co. Inc. Metal Products Div. Baltimore, Md. | 1A, 1T, 1C, 1E, 1F, 1G | Fixed | 50-2000 | \$200-1000 | 3 to 5 | 4" to 12" | Wt. | 0-40, 0-60, 0-80, 0-100 AD-1, AD-2, P-1, P-2, P-3, P-4 |
| Aircraft Aircraft Propellers Excess Co. Inc. Metal Products Div. Baltimore, Md. | 1A, 1T, 1C, 1E, 1F, 1G | Fixed | 500-2000 | \$500-1000 | 3 to 5 | 12" to 24" | Wt. | AD-1, P-1, P-2, P-3, P-4 AD-2, AD-3, P-1, P-2, P-3, P-4 |
| Aircraft Aircraft Propellers Excess Co. Inc. Metal Products Div. Baltimore, Md. | 1A, 1T, 1C, 1E, 1F, 1G | Fixed | 50-200 | \$200-1000 | 3 | 40" to 100" | Wt. | AD-1, P-1, P-2, P-3, P-4 AD-2, AD-3, P-1, P-2, P-3, P-4 |
| Aircraft Aircraft Propellers Excess Co. Inc. Metal Products Div. Baltimore, Md. | 1A, 1T, 1C, 1E, 1F, 1G | Fixed | 50-200 | \$200-1000 | 3 | 40" to 100" | Wt. | AD-1, P-1, P-2, P-3, P-4 AD-2, AD-3, P-1, P-2, P-3, P-4 |
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doed under fiscal 1950 procurement as yet in production.

1950 Pratt & Whitney originally ordered with fiscal 1948 contract authorization, such as North American's F-86 and B-45 are just beginning to roll off assembly lines at a significant rate. The program is a whole well set now into the high volume production phase until 1954.

Another significant responsibility in the industry is that of subcontracting on an expanding scale. USAF particularly has indicated that it favors subcontracting as a method of keeping firms going who do not receive prime contracts as engine contracts, along with the largest share of the current military aircraft contracts, is subcontracting nearly 50 percent of its work, much of it in engine subcontracting, to other manufacturers low on prime contracts.

Industry Problems—Among the problems still facing the industry are:
• Five-year procurement program—Legislation authorizing a five-year contract authorization program for military aircraft procurement is still being drawn

on Capitol Hill although there is no outstanding opposition to it. Passage of this bill would help level all the major patterns of high price and deep valley of aircraft production and allow companies to plan production more effectively.

• Integration—Details of new organization of aircraft procurement contracts will be handled but not yet determined by the National Military Establishment. Until this is set, profit margins are uncertain.

• Technical progress—Extremely rapid technical progress exemplified by jet propulsion and supersonic flight have forced military services to stress their aircraft procurement plans more often than usual, resulting in an especially rapid retooling of military business within the industry. Expanding defense plans are the key to this staff technical conversion. Production techniques are rapidly changing in high speed jet-powered planes account for a larger volume of the industry's work.

• Morgan-Mifflin officials have indicated they believe the aircraft manufacturing industry now has too many

firms to be adequately supported by percentage production and less urgent requests among existing companies in a series of reducing management overhead while retaining production facilities for emergency use.

Women and Jobs

Proportion of women in aircraft jobs climbed at 13 percent during 1948, and there are no indications that this will be increased soon, if at all.

Total number of women employed rose during the year, but only in direct proportion to the increase in total employment, according to the U. S. Employment Service.

At the peak of the war, there were nearly 200,000 women in aircraft plants, between 35 and 40 percent of the total. Today they number 50,000 jobs, many of them clerical.

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Scheduling Problem In Materials Flow

Equilibrium in the aircraft industry will have to stay as short as this year's long, important materials flowing into production lines.

While Congress adds to the President's budget, far placement of aircraft in the big unknown future is determining just what materials will be critically short.

The Materials Board figures that up to a billion dollars over the Presidential budget figure can be absorbed without causing any trouble. If the war is traced any more than that, the demand by the aircraft industry and its suppliers might cause some real stress.

On the present basis, the industry does not expect any critical shortages of materials, but there will be times when fast thinking and even faster footwork will be in order to keep the flow of materials going. It will be a problem of scheduling, rather than actual shortages, according to the Materials Board. The Air Material Command at Wright Field has a materials scheduling committee meeting which will be instrumental in helping manufacturers lock their spot shortages problems.

► **Aluminum**—Continued in a popular reservation, aluminum sheet will not be a shortage problem. Extraneous, however, will be short, not seriously, but enough to demand close attention by thickness and quantities. Many problems here will be to see that one company does not accumulate a large reserve of a light commodity, while another is down to the last two feet.

Magnesium, although in increasing use in military planes, is not expected to be short enough to curtail any production.

► **Steel**—High-temperature steel alloys will be fairly hard to get, mainly because the steel industry will be both 50 years out the small quantities needed in airplane production. Expenditure again will have to do a lot of arranging around warehouses. Another stress there may be shortages here in that several of the alloying materials, mainly cobalt and columbium, are currently short and the steel people are finding them hard to come by.

There are no problems anticipated regarding copper, zinc, cadmium, nickel, molybdenum, or other non-ferrous materials. There is one exception—lead. This heavy metal is in short supply, the world over, and there may be some spot shortages of it in such areas as ballistics steel, which is ballistics steel. Here again, however, it will be up to the expeditor to work out schedules of delivery with the industry and Wright Field.



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ing air production workers, to nearly 245,000.

All stage aircraft centers except Conquest expect to hold or raise their employment. Heaviest hiring will be in Los Angeles and San Diego, where there have been lay-offs, and in Dallas, new home of Chance Vought.

The versatility of aircraft labor makes by area bids as to general supply and types of skills. Generally speaking, however, there is a shortage in the technical skills—engineers, tool and die makers, designers and others used in the tooling up process. Situation has eased on production line, plant-floor operators, lathe operators, etc.—many of them coming from other manufacturing industries.

► **Wage Rate-Up** in other industries, aircraft wages rose sharply last year as the final award of positive wage increases. Average hourly earnings jumped from \$1.46 to about \$1.54 in aircraft and parts and from \$1.46 to more than \$1.61 in engines. Weekly take-home went up even more as employers walked more hours each week.

Weekly hours in aircraft and parts rose from 39.4 to 40.5. In engines, they went up from 40.6 to 41.2.

► **Wages Keep Rising—Control**, wages will keep rising this year, but it will be more gradual. The unions are giving more attention to pensions and other social security benefits now that the ticking clock of living wages has cheapened their chances of getting much higher wages.

Analysis of labor supply conditions in major aircraft centers, reported by Max Gladys Fiedler at the ASES staff, shows the following situation at the end of the year.

► **Los Angeles—Demand** for skilled technical workers—stress analysis, aerodynamics, mathematics and physics. NASA-wide recruiting for aeronautical engineers not successful. Few job opportunities for unskilled and semi-skilled workers.

► **San Diego—Demand** for skilled workers will be filled from temporary lay-offs. Surplus of production workers will be subsisted by summer.

► **Seattle—Except** for skilled draftsmen, engineers and mechanics, needs are being met locally.

► **Dallas—Local** suppliers moving aircraft for the first time and workers from other areas, including transfers from Bridgeport, are filling most of the job gaps.

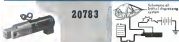
► **Fort Worth—Significant demand** for experienced aircraft workers, including engineering designers, mechanical engineers and tool designers. Some engineers are being recruited from outside Fort Worth. A midwinter run in temporary work is beginning using the local labor market.

► **Wichita—Most urgent demands** are

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AD-1000, AD-1000A, AD-1000B, AD-1000C, AD-1000D, AD-1000E, AD-1000F, AD-1000G, AD-1000H, AD-1000I, AD-1000J, AD-1000K, AD-1000L, AD-1000M, AD-1000N, AD-1000O, AD-1000P, AD-1000Q, AD-1000R, AD-1000S, AD-1000T, AD-1000U, AD-1000V, AD-1000W, AD-1000X, AD-1000Y, AD-1000Z



AD-1000, AD-1000A, AD-1000B, AD-1000C, AD-1000D, AD-1000E, AD-1000F, AD-1000G, AD-1000H, AD-1000I, AD-1000J, AD-1000K, AD-1000L, AD-1000M, AD-1000N, AD-1000O, AD-1000P, AD-1000Q, AD-1000R, AD-1000S, AD-1000T, AD-1000U, AD-1000V, AD-1000W, AD-1000X, AD-1000Y, AD-1000Z

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BETHPAGE

LONG ISLAND, N. Y.

Each union operates on an industrial basis. That is, they try to sign up all employees, regardless of the job, skill or craft. Nurses, office workers, waiters, production workers, skilled mechanics—all are eligible. Under the Team Union, too, both unions have encountered trouble with AFL, each union, like the electronics, which try to get separate bargaining rights for their units.

► **Conservative IAM**—The IAM is an old-line, conservative AFL union. It has been in and out of the AFL, several times because of jurisdictional differences with the carpenters over millwrights. Unlike UAW-CIO, the IAM does not have a separate department for aircraft, although it has "representational judges" at aircraft plants.

IAM President Harvey W. Brown met with the House TB under the IAM retirement bill plan. He will get a \$300 monthly pension.

► **Stepped Up, UAW-CIO**—Aircraft as glasscock activity has been stepped up under Vice President John W. Edwards, director of the union's aircraft department. More than \$66,000 was spent on aircraft negotiation during the last fiscal year, compared with less than \$20,000 the previous year.

Bertha's anti-Communist administration has had complete control of the union since the last convention in November, 1947. But another fight is brewing in the next gathering in Milwaukee on July 10. Two groups, one pro-Communist, oppose Bertha.

Strikes

Source in the Labor Dept. expect that, as the aircraft program spreads, the number of strikes and work stoppages will be fewer and less severe. "Tendency will be for union negotiators to 'get tough' if any craft manufacturers delay wage increases which they feel the companies are obliged to pay on their government contracts."

In this connection, it is interesting to note that the number of strikes in aircraft has decreased every year since 1944 when the production of airplanes started downward. Conversely, then, they would increase on the upswing.

Here are ILS strike figures for aircraft, parts and engines:

| Year | Number of Strikes | Workers Involved | Members Affected |
|------|-------------------|------------------|------------------|
| 1944 | 202 | 180,000 | 180,000 |
| 1945 | 85 | 100,000 | 100,000 |
| 1946 | 21 | 21,000 | 21,000 |
| 1947 | 30 | 3,000 | 4,000 |

Figures for 1948 are not yet available, but the number of strikes should be less than the 10 last year.



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J-M Thermoflex Insulation for jet planes...

...completely sealed to eliminate fire hazard!

Now a completely sealed flexible blanket having outstanding insulating properties has been produced by Johns-Manville Research for jet engine exhaust nozzles, turbine casings, tail pipes and guided missiles.

This new Thermoflex Insulation Blanket is exceptionally light in weight. Insulated structures weigh almost 50% less than those insulated with conventional materials. The conductivity of the Thermoflex Blanket (1/4" thick) is only 0.75, compared to the insulating value of a 1/4" thick conventional material. The blanket is completely sealed to eliminate fire hazard.

All Thermoflex Blankets are custom-made. In addition to the completely sealed blanket type (G), they are also available with a flange on one side only or flange against perimeter of cell from the other side (type C) and in a special design for guided missiles (type CH). Each of these three basic types is available in special shapes for heat exchangers, tail pipe clamps, inner exhaust cone discs, and for protecting vital equipment in the hot zone.

For further information write Johns-Manville, Box 250, New York 16, N. Y.



Type G Thermoflex Blanket for jet engine exhaust cone. It is completely sealed to eliminate fire hazard.



Type CH Thermoflex Blanket for guided missile. It is completely sealed to eliminate fire hazard.



A special type Thermoflex Blanket for turbine casing. It is completely sealed to eliminate fire hazard.



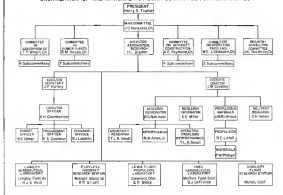
Section of Type G Thermoflex Blanket for turbine casing. It is completely sealed to eliminate fire hazard.

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RESEARCH

ORGANIZATION OF THE NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS



Air Power Strength Starts in the Laboratory

U. S. has aeronautical leadership through research effort that has had to expand as well as catch up.

By Robert McLarron

U. S. aeronautical science has assumed world leadership in the new realm of high speed flight, a leadership it came previously close to losing irrevocably during World War II. But generally available knowledge, together with the high productivity level of current progress, permits our scientific advances to assist the citizen at our fingertips in the field over the world.

This leadership was not gained through the simple process of "catching up" but gained, which can often be accomplished through their research in effort. Simultaneously, U. S. aeronautical research found itself racing over a constantly expanding distance, a con-

tinuous combination of a spirit and an endeavor more. The original lost distance has been covered many times over since V-J Day but even today aeronautical science finds itself racing an ever-widening gap.

Not Unique—Only constant in the frustrating situation is that it exists, too, in Soviet Russia, which has neither the experienced technical knowledge nor the freedom of scientific discovery enjoyed here. U. S. aeronautical research leaders admit little or no knowledge of the scope, direction or capability of the Russian aeronautical research effort.

The conclusion that the U. S. leads in based of security on a simple evaluation of the aeronautical position now being faced and the quality and

quantity of computer and equipment required for their solution.

The location and present capacity of the world's leading aeronautical laboratories and their number is surprisingly small—11 well known both here and abroad and while this is only an approximate index to the productivity of research effort, past experience indicates that such an approach to the problem of "winning" versus nation's scientific importance is fundamentally sound. A factor of equal importance is the magnitude and quality of research equipment in which their results are stored. The U. S. stands several years ahead of the unassisted, war-torn nations of the world.

In the Dark—But this leadership is a massive thing, it can be lost overnight, threatened, without knowledge of the science and destroyed in a blind effort of effort into which only constant science

U. S. High Speed Research Airplanes

| Manufacturer | Designation | Engine | Span | Length | Height | Gross Weight | Max. Design Speed |
|--------------|-------------|---|---------------------------|--------|---------|--------------|------------------------|
| Bell | X-1 | Reaction Motors rocket 6000 lb. thrust pressure fuel system | 29' | 31' | 10' 10" | 13,000 | 1000 mph @ 40,000 ft. |
| Bell | X-1A | Reaction Motors rocket 6000 lb. thrust pressure fuel system | 29' | 31' | 10' 10" | 13,400 | 1700 mph @ 50,000 ft. |
| Bell | X-2 | Curtis Wright rocket | Sweep wing, variable mast | | | | 2150 mph @ 300,000 ft. |
| Douglas | X-3 | Various | Design under study | | | | 2400 mph @ 350,000 ft. |
| Northrop | X-4 | 2D Weyburnhouse TRS-10B 1500 lb. thrust jet | 21' | 32' | 10' | 7,000 | 410 mph @ 10,000 ft. |
| Douglas | D-555-I | 4 R. Allison J-33 4300 lb. thrust | 22' | 45' | 12' | 18,000 | 610 mph @ sea level |
| Douglas | D-555-II | Weyburnhouse 2FC, 3000 lb. and Reaction Motors rocket 6000 lb. thrust | 22' | 45' 3" | 13' 6" | 18,000 | 1150 mph @ 31,200 ft. |



Bell X-1



Douglas D-555-I



Douglas D-555-II



Northrop X-4



AIR-BORNE SELF-STARTER FOR JETS

A successful air-borne, self-starting system for jet and turbo-prop aircraft engines was recently announced by the Navy's Bureau of Aeronautics.

Developed and manufactured by AiResearch, this device makes it possible to start jet and turbo-prop aircraft without the use of a prop-driven trailer of storage batteries, 255-lb. generator and ground crew. The new system saves valuable time, equipment and personnel and allows such aircraft to be started anywhere, any time, and under any conditions.

Heart of the new self-starter system is a newly developed 255 lb. multi-per pass auxiliary gas turbine—the first radial inward flow power turbine of the air jet type ever perfected. It is the first auxiliary gas turbine of any type to pass proofing

250 hour government qualification tests. Combustion temperatures as high as 1600° F. and wheel speeds as fast as 50,000 rpm make possible its very high ratio of power low weight and size.

• AiResearch engineers, designers of rotors operating in excess of 100,000 rpm, tackle your toughest problems involving high-speed shafts. Specialized experience is also available in creating compact turbines and compressors; actuators with high-speed rotors; air, gas and fluid heat exchangers; air pressure, temperature and other automatic controls.

Write: AiResearch Manufacturing Company, Los Angeles 45, California



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Aeronautical Research Budget

| Agency | Fiscal 1949 | Fiscal 1950 |
|----------------------------|----------------------|----------------------|
| Air Force | \$124,416,790 | \$215,000,000 |
| Navy Bureau of Aeronautics | 180,000,000 | 40,000,000 |
| NACA | 12,810,000 | 40,700,000 |
| Ordnance Dept.—Army | 45,424,123 | 67,125,000 |
| Bureau of Ordnance—Navy | 67,568,050 | 62,150,000 |
| CAA | 1,800,000 | 1,800,000 |
| TOTAL | \$428,920,964 | \$454,885,000 |

tic vigilance can throw light. For these reasons, nothing less than a constant acceleration of research effort is to be desired as a grave national risk, the effects of a slackening of research effort are obscured for as long as five years—and then it is too late.

It is the emergency of the aircraft from its inherent weakness in its supersonic freedom that has caused the most serious problems of aeronautical science. A research result that increases an airplane's speed 50 m.p.h. automatically demands a dozen new problems demanding solutions. These solutions, in turn, multiply themselves into a series of problems that can be solved only by isolating a mechanical portion and attacking it with concentration.

► **Task Force—Aeronautical research is conducted most effectively by a small "task force" of specialists. First, it is the function who attacks the problem by mathematical methods that indicate the direction of approach. Next comes the research engineer who tests these theories in the wind tunnel as the special facility requests to reach the air stream of supersonic freedom. Third comes the design engineer who interprets these research results into a specific aircraft design.**

Last comes the test, the Air Force, Naval Aviation or the Army, who evaluates the design in terms of performance, safety and suitability for the job. Then begins the long period of development of the article, which manufactures and the test, attended, as required, by new research results. Only in this heterogeneous but closely coordinated way can maximum progress be secured.

The foregoing provides an index to the complexity of the question "Where do we stand in aeronautical research?" Our major research problem is acceleration, the study of air in motion. The principal difficulty in this field is to obtain an understanding of the transonic zone, long past by and just above the speed of sound, both areas of which are now fairly well understood.

► **Consequences—In the realm of transonic aerodynamics, science is substantially stunted in a number of special configurations required for the produc-**

tion of lift and the reduction of drag. The general design requirements for achieving these ends are through the use of wing sweep, low aspect ratio plan forms, laminar air and double slot profiles.

But badly needed are the data required for placement of these configurations in the wind tunnel. The data required are the stability and moment in design for the last previous points to the coefficients. Configurations are now available that require such vital data in accelerating stability and control. It enables it transonic speed but information is lacking on the modifications needed to extend the narrow range of subsonic to transonic landing and movement speeds.

Drag data are available on individual components of aircraft and results at transonic speeds, and information is available for the design of maximum drag forces of these components. But research is badly needed on methods of calculating the total drag of these components when placed in combination, such as the completed aircraft in steady flight. Interference between these components corrects and finally comes into accurate patterns that defy analysis to accurate degrees. These studies in quiet high speed wind tunnels of large scale models and accurate and highly accurate methods of measurement of stresses in energy on the surface.

► **Stability—Propulsion—Stability and control theory has shown remarkable progress in the past year made possible by advanced mathematical methods developed during the period, and the use of special calculating equipment. However, much of the actual design data must still be extrapolated by methods of widely varying accuracy to full-scale parameters. Of enormous help in this program has been the piloted high speed flight research program.**

The Bell X-1 has already provided a tremendous quantity of helpful data on stability and control at transonic speeds, and the continuation of this effort program is now fairly well understood.

The problems of internal aero dynamics are still complicated by the transfer difficulties of boundary-layer

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DC-6

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analysis. Now when an new fairly well understood with standard data already referred to in the form of design charts. Wing cases, particularly in the rear section, are not so thoroughly analyzed but considerable effort is being directed to these problems due to their importance on pressure recovery and its large effect on power plant performance.

► **Structural-Stress** research problems apparently multiply with each solution due to the simple fact that structural loads are growing lighter while wing dimensions are growing smaller. If present knowledge was suddenly scaled off, it is obvious that these converging lines of development would soon merge into an impossible situation.

It is the current aim of structural research to keep these two lines apart by providing stronger materials and structures of greater density. Substantial progress has been shown in theoretical work along these lines but a broad gap remains between available data and actual application to the fabrication of new air stock and completed aircraft structures.

Greatest effect is presently being expended in research on panel buckling, loads of permanent buckling, vibration, pressure ridges, plasticity, low-density materials, utilization of girders, tension field beams, flutter, rib stiffeners, and study of stiffeners, skin stiffener panels, cut-outs, lightning holes, general suitability of shells, shear lag and methods of reduction of test data to aircraft.

New fabrication methods have already been introduced for bonded skin sheets, integral stiffeners, attachment methods and analysis of structures utilizing these forms and shapes.

► **Propulsion**—It is probably in the field of aircraft propulsion that the greatest research progress has been shown since WWII. Extensive new lines of fan base and rocket development has been thoroughly analyzed and developed with the result that there is now available a large mass of design data awaiting application.

However, knotty problems continue to exist before this application, particularly in the fields of high-temperature alloys. Available research data has been directed in great detail (the need for this to be gained) through the use of higher compression ratios and higher combustion heat release, but the application of these data hangs wholly on the outcome of the present battle with heat resistant materials. Great progress is being made in this battle but the field apparently will require the fabrication of radically new materials employing materials needed to realize a success in this.

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5

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of 10-75,000 psi, then the size of data on high performance turbine engines can be applied and specific power out puts will soar.

► **Conductivity Achieved**—Much of the apparent lack of coordination between various research activities serves the nation has now been resolved. Thousands of projects of obvious duplicity have been cancelled and those countries parts strengthened. While some of research have been transferred from one agency to another and lines of responsibility are now reasonably and carefully drawn within the limits of workability.

But the best method of coordination still remains the concerted force of its service with a focus on its experts in the field working down and climbing out ideas, experiments and proposals which could not possibly be evolved in a single man, or group of men leaving heavy financial and executive support behind.

► **Costs-Buzzards** costs continue to rise, not alone due to the general price rise in the nation. As the pursuit of technological knowledge of a particular subject begins to lead into narrow, hidden corners of detail, special equipment and techniques are required that are expensive to plan, develop, build and operate.

Others in the past, the range of data desired was discovered to be entirely within the range of accuracy of the measuring equipment, obviously as no possible situation. Wind tunnel tests turned to a typical example. Until the problem of turbulence measurement was solved it was impossible to develop or reach data in lowest boundary layer flows.

Technological research in such new sciences as guided missiles, electronic control, superconductors, etc. has had to wait backward and forward at the same time, developing fundamental theories while producing practical design data. Much of this background work now has been recognized so that the major effort now can be directed towards the production of detailed designs.

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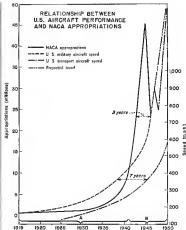
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In Area A, basic research funds were low; major attention was to develop research methods. In east and westward areas, Area

8. performance began to parallel expenditure, with the indicated gap for research to show up as a result in close speed.

High Speed Flight Research

The decision of the U.S. Government in 1944 to undertake a program of piloted high speed flight research was made on the basis of necessity rather than convenience.

First, it had long been suspected that the wind tunnel could not produce accurate results in the vicinity of Mach 1.0, the speed of sound. At this speed a normal shock forms directly across the throat section of the tunnel resulting in a complete breakdown of the airflow and wholly unreliable instrument read-

Blank Spot—It had been hoped that careful design might narrow the "choked" condition to a very narrow band of speed on either side of Mach 1.0 by means of tunnel shape, actuator-belted sections, etc. But at the time reliable readings were obtained only on

to about Mach 0.95 and above Mach 1.15, leaving a band of 0.2 in which no data could be obtained. Yet it was precisely this narrow band that held the greatest interest for aircraft designers.

Another vital factor was that although stability and control data may be calculated and tested under very limited conditions on small models, the conversion of these data to full scale is not yet an exact science. And stability and control were two of the major questions posed by early high speed flight. Only a pilot in an airplane trading in the vicinity of Mach 1.0 could properly determine the handling characteristics of the machine.

► **Start of Program**—Based on these two primary problems, together with other questions of structure, power plants, low speed characteristics of high speed



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Since then many famous names—Broken-baker, Lindbergh, Wiley Post, "Hay" Arnold, "Tooty" Sparta, Hoyt Vandenberg and scores of others—have written glorious exploits in aviation's handbook.

The India Airlift today grows in peace what the India-China "Hump" proved in war—that air transportation's ability is matched only by its flexibility.

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Aviation, etc., the U.S. Air Force, Naval Aviation, National Advisory Committee for Aeronautics and two carefully selected private manufacturers merged their respective talents into a national piloted high speed research program that has since proved exceedingly successful.

On thistles of warlike NACA usually, together with captured German research data available later in the program, these were four major means of approach to the problem of highly speed flight: wing wings, swept wings, low aspect ratio wings and high speed wing profiles. The program we had done is encompassed the entire range of these possible solutions: the Navy to handle low speed ratio and wing sweep, the Air Force to handle thin wings and wing sweep, NACA to handle aspect ratio wing profiles. One other idea, the tailless, was added to the program later.

One of another of the airplanes was completed and test flown and the pilot research program began to show results. The airplanes were designed on the basis of NACA research data by individual industry design teams and sponsored in the form of regular Air Force and Navy airplane procurement contracts. The program was named to honor Air Force Gen. Col. Walter H. Dorn, who the hard dry life had provided a numerous times major loss, and was administered jointly by Air Force, Navy and NACA.

X-Months: The Lunar Riller X was the first to be completed and the first to attain supersonic speed, on Oct 14, 1947. This airplane was extremely thin wing profile and a rocket powered. Second place to fly was the Douglas Navy D-558, which is a tailflop powered and features low aspect ratio (short broad) wings. It established a world speed record (since exceeded) of 600 mph. on Aug 25, 1947. Third to fly was the Douglas D-558-II, featuring a combination of low aspect ratio and variable wing planform. It was both a tailflop and rocket, most of observers believe it will prove the design superior over built.

Latest research airplane to fly is the Northrop X-4, a special Air Force project to examine the stability and control of aircraft flying steadily in the vicinity of sonic speed and to examine the possible effects of the bullet-nose wing design. Thus, the X-4 will fulfill a dual purpose: it will provide research data as a part of the general program and will also provide data for the bullet-nose wing design for specific problems in high speed fighter aircraft design.

► **Yet to Come—Still** to be completed and flown is the Bell X-2, a supersonic version of the highly successful X-1. Completion of this airplane has been delayed while needed information is now available on the performance of

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Kunst Stroh have improved extruding characteristics. They have better machinability, and they are easier to seal. Therefore they can be turned into superior finished parts at lower cost.

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the N-3, and by delay in the completion of the Cactus Propeller-driven rocket motor.

Remaining project is the Douglas N-3, which is still in the preliminary design and layout study stage with more than 50 different designs being completed and studied ranging from short, stubby to long, thin configurations and the complete range of high speed power plants.

So will the N-3 do its job as a diving aircraft? Industry that the Air Force has ordered a limited production quantity of four airplanes to broaden the program.

Engine Definitions

Here are definitions of the major propulsion systems as used by aircraft today.

• **Gas Turbine**—Any of a family of propellers which utilize a turbine to take energy from a stream of hot gases for doing useful work, extracted from the combustion shell.

• **Turboprop**—As it differs in the compressor inlet, compressed to a high pressure, passes through a combustion chamber, where fuel is added and burned and the high temperature products expand through the turbine that drives the compressor and continues to expand through a nozzle as a jet in the atmosphere.

• **Turbopump**—A turbine engine in which the turbine is geared to drive a propeller. When a portion of the hot gases is ejected through a nozzle, the unit is frequently referred to as a jet.

• **Compositional Engine**—A conventional reciprocating engine to which a simple flow exhaust gas turbine and an auxiliary supercharger are added. The engine exhaust gas is ducted to the turbine which is provided with a simple jet propellant. The turbine drives the auxiliary supercharger and the exhaust turbine power is delivered to the engine crank through gearing. An auxiliary is provided for cooling the engine charge air after the auxiliary compressor.

• **Turbosupercharger**—A conventional turboprop engine with provisions for reheating the gas between the turbine discharge and the exhaust nozzle. Actually a form of constant thrust augmentation, the combustion system makes it possible to obtain higher temperatures in the exhaust jet than can be sustained by the turbine.

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CIVIL FLYING

Business Flying: Civil Backbone of Air Power

Use of four-place planes by commercial travelers often proves the cheapest way to cover a territory.

By Alexander McHenry

The steadily growing number of individual and commercial companies and individuals, business and professional men who have learned to use executive aircraft in busy business trips are civil flying's best customers and best prospects in 1948.

A total of 25,599 airplanes were used for business flying in 1947 and flew 1,564,908 hr. as compared to an overall total of 86,788 aircraft flying 16,177,080 hr. last available CAA reports show. Most of these airplanes were used for other purposes as well as business, and most of them were individually owned. An American Wings estimate places the total number of corporate-owned aircraft at around 1500.

► **Best Salesmen**—Probably the best references for business flying are today's successful business men who have found cold executives in having their own air transportation available to carry them where and when they want to go.

A small number of aircraft operator operators who have come to appreciate the importance of good customer relations with the top executives who travel in their own planes, makes another plus factor in the expansion of business flying.

But probably the most important item in selling business aircraft is the performance of the airplanes themselves, showing a few hours' time which would represent days by one-time transportation. Yet, even in many cases are directly comparable in cost.

► **Whisperers**—Some evidence of this is found in testimony by business flyers:

H. R. Berg, Columbus, S. C., insurance consultant (Boeing four-place Bonanza)—I took to the firm Columbus and made a trip to Richmond, Va., New York City, Auburn, N. Y., Battle Creek, Mich., Chicago, Lexington, Ky., and returned to Columbus. Total direct mileage, 2668. Total flying time, 17 hr., 15 min. Average ground speed, 155 mph., average fuel consumption 9.9 gal./hr. Average altitude 7000 ft. In four days I covered all of this territory which slipped me a full day in New York, half day in Auburn and a full day in Chicago to transact my business. Total

Civil Pilots

CAA estimates approximately 508,000 certified civil pilots in the U. S. as of Jan. 1, 1949.

Total includes these groups:

Aircraft transport pilots 16,800
Commercial pilots 210,800
Private pilots 270,800

Total certified pilots 508,000

Number of student pilot

certificates issued in

1948 177,315

Number of private pilot

certificates issued in

1948 86,836

cost of trip including insurance, depreciation, fuel and baggage was \$49.50. I had one passenger.

Bob Noble, Oakland, Calif., insurance broker (Stinson intermediate Voyager)—Mr. Stinson said for itself in a few months on routine business trips of 50 to 1000 miles. It adds plenty in my leisure time. I travel a comfortable 60,000 miles a year in 15 days and still keep up with my paper work on the office.

Benny Goldwater, owner of Goldwater, Phoenix, Ariz., specialty store, (Boeing four-place Navion)—We fly weekly between Phoenix and Prescott and twice monthly by Navion to Los Angeles and other marketing points. That's part of our marketing plan. Navion time to Prescott is 40 min. and to Los Angeles 2 1/2 hr. Air time to Prescott is 40 min., to Los Angeles 1 1/2 hr. This plane is the best for selling on customers at markets and before off highways, and for making home deliveries.

► **Survey**—A Getz-Wilfong Dept. of Commerce survey on aviation outlook for private flying (1945), which covered worldwide aviation in terms of other forecasts, estimated that approximately 30 percent of commercial traveling could be done by air.

It is estimated that as a bulk of 15 to 2 billion miles covered by commercial travelers in planes appear

nately 43,000 to 50,000 planes would satisfy this need.

The estimate was made on a basis of existing commercial travel by auto, and did not consider the additional mileage possible in the case of travel because of the higher speed of the plane. The survey indicated there were approximately 250,000 in the group private, that they used their cars approximately 500 hrs. a year, and would approximately 10,000 mi. a year in travel.

Using the conservative 3-to-1 ratio of business plane speed to automobile speed this would indicate that the average airplane commercial traveler could travel approximately 37,000 mi. a year in the same time, or could cut his travel time to one third, having some 150 hr. additional time to spend on actual business relationships. It is interesting to compare the 57,000 mi./yr. theoretical figure with Mr. Noble's 60,000 mi./yr. report shown above.

Corporation Aircraft Design Area, New York, an association of companies operating their own airplanes for business travel, has already taken on some activity with designation of C. B. Gaddy as executive secretary. Primary work of organization will be study legislation and regulation affecting the group work with other aviation groups for common interests, exchange information and promote aircraft safety, economy and improvement in design.

► **Sales**—In 1948 the 10 general aviation aircraft producers reported a total shipment of 1465 four-place planes and 3184 two-place planes.

An American Wings forecast at the 1949 new plane show is approximately 6000 planes. Approximately 5600 will be four-place and 2400 two-place.

The 1947 CAA aircraft survey showed 31 percent of the planes in operation were used in business flying. This percentage of the 1948 actual and 1949 estimated production would add nearly 5900 business planes to the 25,599 estimated in 1947. However, CAA analysis report a substantial of planes at the rate of approximately 15 percent a year. It is also estimated that the 1948-49 estimated new production would only hold the level.

Continuing increase in the number of business planes, in which all logical industries must, probably will come about gradually through better production in the used airplane market, and partially through a stream of aircraft use

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The Acme No. 2 Swastika uses 23 Walde Truarc Retaining Rings in position and hold shaft square (right) keep pressure

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Safety

Progress is made, but accidents resulting from stalls show increase.

Slow but perceptible progress toward greater safety in non-air carrier flying is shown in the CAA analysis of accidents in the record flying year of 1947, when 16,117,000 hr. were flown, an increase of 67 percent over the largest previous total of 9,653,100 hr. in 1946.

During 1947 (last year for which complete figures are now available) there were 9253 non-air carrier aircraft accidents in which persons were injured or killed, including 582 fatal accidents and 567 accidents in which serious injuries were suffered.

On a basis of hours flown, the accident rate was reduced appreciably in 1947 from 1946, dropping from 7.8 accidents per 10,000 hr. to 5.7 accidents in the same number of hours.

Reckless flying is charged of safety accidents in small commercial for a large proportion of the fatal accidents (40 percent), but this percentage was slightly reduced from 1946 when 47 percent of the fatal accidents involved CAA violations.

Despite positive trends toward greater aircraft safety and the development of effective stall warning indicators, the record of stall accidents increased in 1947 with 433 fatal accidents (49 percent of all fatal accidents) and 239 serious injury accidents (41 percent of all serious injury accidents) reported last year alone.

Stall violations again were a serious factor in the stall accident totals. Of the fatal stall accidents 149 (32 percent) took place during routine flying and 11 fatal stalls during instrument weather flights without pilots.

Instrumental flying showed continued improvement in safety. In 10,371,000 hr. of this type of flying there were only 257 fatal accidents in 1947 at a rate of 0.2 fatal accidents per 10,000 hr. The 1946 rate was 0.17/10,000 hr. for instrument flying.

Non-commercial flying accounted for 51.6 percent of all accidents, 40 percent of fatal accidents and 25.6 percent of the hours (4,618,000). Amount of non-commercial flying nearly doubled over the previous year's total and the rate of fatal accidents in this type of flying dropped in 1947 to 1.1 in 10,000 hr., as compared to 1.4/10,000 in 1946.

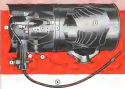
Commercial and noncommercial flying was the only type to show a slight dip in hours flown last 1947, attributable probably to the high utilization of available experienced pilots and aircraft for instruction in CAA flight schools. Com-

MINIMUM MAINTENANCE + MAXIMUM SAFETY Put This Heater in the Nation's Leading Aircraft

South Wind's "321" Aircraft Heater with 200,000 BTU capacity is selected for Boeing, Cessna, Lockheed, Martin and North American aircraft. Easy installation and maximum maintenance are afforded by the sturdy simplified construction of this "heated floor" heater. The section burner, including fuel stock and spark plug, can be removed and serviced in minutes! The vented spark plug prevents fouling and insures automatic gap maintenance.

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South Wind's "321" is the only 200,000 BTU capacity aircraft heater which meets the rigid CAA life and safety requirements for thermal anti-icing. The "321" also has Yellow Dot Approval of the U. S. Army Air Forces for maintenance operation. High explosive resistance under severe testing conditions proves the greater safety and efficiency of South Wind "heated floor" design. Here, in detail, twenty leading airlines list the South Wind...



A. IGNITION CABLE—Horizontally sealed and shielded to prevent radio interference.

B. BURNER—Jet engine type burner will operate over complete range of flight conditions without need for adjustment or fuel controls.

C. VENTILATED SPARK PLUG—Dual electrode type with ground electrode attached to spark plug housing.

D. HEATER CASE—Rugged but lightweight stainless steel, for utmost in safety and accessibility—headed off both ends for quick easy attachment of ducting.

E. BURNER HOUSING—All-steel—high quality stainless steel—completely separating the combustion system from the venting air system.

F. HEAT EXCHANGER—Horizontally sealed, all-welded, stainless steel heat exchanger incorporating multiple surfaces and forms South Wind "heating floor" to maximize efficiency. High heat transfer efficiency.

G. BURNER HOUSING COVER—Protects fuel battery assembly for quick servicing of burner, valve and spark plug assembly.

H. FUEL NOZZLE—Pressure type spray nozzle, meters fuel stream precisely for peak combustion efficiency; no carbon checks result from combustion products to eliminate nozzle deposits.

I. FUEL LINE—Integrated stainless steel line and needle holder assembly—no fittings or joints in fuel—entirely sealed in combustion system—deadly resistant from venting air stream.

J. COMBUSTION AIR INTAKE—Separate combustion air ducts completely isolated from venting air stream.

K. FUEL DRAIN—New wing type drain means complete, safe removal of excess fuel.

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control and reconnaissance flying also showed improved safety with 0.6 fatal accidents in 10,000 hr as compared to 1.1/10,000 in 1946.

Accidents were classified as follows: landing, takeoff and taxing, 3766; collisions with objects other than aircraft (trees, towers, bridges, etc.) 3135; winds, 1714; sustained failures in flight and on ground, 1228; collisions between aircraft, 581; propeller accidents to people, 50; fire, on the ground 17, in flight 23; miscommunication, 44; and undetermined, 17.

Primary accident causes were listed as:

Industrial Use of Aircraft Growing

So valuable are small planes in spraying and dusting that two manufacturers are building special models.

Experience of the use of aircraft in the U. S. as industrial tools, which was accumulative in 1946, promises to continue at possibly as even faster rate in 1949.

Most rapid has been the growth of aircraft use in spraying and dusting for pest and weed control and as a means for seeding and fertilizing of areas which cannot be profitably seeded by surface means.

► One-time chief rival in this aircraft aerial spraying is a special purpose tool because of the aerial vantage point which it offers.

Aerial photography, mapping, surveying, patrols of frontiers, pest control, fire fighting, crop dusting, fog-fogging, radio aid, search, coastal prospecting, hunting, staking, stacking, baling and airmail with fish, clothing, crops and livestock, and blimp electronic sign advertising.

At peak of the 1946 season, some 5000 CAA were putting one-way wires in for low flying to spraying, dusting and seeding operations at the rate of 400 a month.

It is estimated that probably half of the 10 million lb. of the new weed-killing 2,4-D chemical used in 1946 was applied to the nation's farm lands by aircraft.

More than 300 towns, communities and most areas contacted in 1948 for air spraying with DDT, malathion or chlordane and other insect pests in new areas.

► **CAA Record**—In June 1948, CAA records indicated there were 501 dusting operations and 694 spraying operations (many of them duplicated) as compared to 186 dusting operations and 12 spraying operations in May of 1946.

Typical of weed control projects is the destruction of sugarbeet and other

pest crops, 6168; cotton failure, 1123; alfalfa, 548; sorghum, 666; other perennials, 215; corn, 200; sorghum, 57; and an undetermined, 24.

CAA analysts point out that planes being dived or flown low over people, buildings or congested areas or being crashed at low altitudes resulted in 511 accidents or only 5.6 percent of the total, but that this small group of "suicide" pilot accidents accounted for 26 percent of all fatal accidents, and nearly one-fourth of the total of 1551 persons who lost their lives.

despite by 2,4-D aerial spraying, on cottonwood, peach, maple, as described in a recent U. S. Dept. Agriculture report. More than 100,000 acres of sugarbeet were treated in 1948 by airplane, at a total cost of \$2 a acre, reducing the loss of the sugar which would have been lost.

Proper operation of one point of the chemical put away an solution of approximately five gallons of oil and water solution is sufficient to produce 50 percent of the sugar brand plants and control the remainder, with some work required during the following summer. Current results from special projects are considered equivalent or superior to those obtained from ground power and the aerial spraying is quicker, cheaper and safer than the spraying process.

► **Excesses Reduced**—Potential of widespread aerial control through aerial spraying and dusting, as the additional specialized products put away to be obtained in common. It has been estimated that the entire cost of the Marshall plan for one year could be saved by the extra food production in this country which would result from a rational weed control effort.

At least two ground plane manufacturers, Piper and Luscombe, have announced development of factory-built 40 hp. 1948 model ground planes designed especially for this work, neither better which may stimulate the further growth of industrial flying. Marshall's most aircraft used have been high-powered lightplanes, in many cases converted from regular primary trainer models.

Use of the helicopter in the field of spraying, dusting and seeding has developed within the last two years, with Bell Aircraft taking the leadership in

this field by manufacturing a special agricultural model of the two-place Model 247 helicopter. The development from the rotor blades and the quality of the hovering helicopter to work at slow speeds is such that the most daring field work operator might hesitate to attempt, under the necessary safety probably the most efficient means yet devised for this work.

However the higher operating cost of the helicopter, added usually as a somewhat higher cost per acre for its services, has held back its progress. In 1947, more than 10 helicopters were used in this work, and this number was increased considerably in 1948.

► **Bulletin**—A CAA bulletin "Industrial Flying" (July 1948) asserts that air pilot planning to engage in dusting, spraying, seeding etc. needs "services of an engineer to design the proper apparatus, a chemist, an entomologist and a pilot pathologist to determine cause and cure of the problem, and a biologist and the pilot pathologist to know what formula will be effective in industrial cases. The lesser series of a crop must also be completely in interest of advantages and limitations."

This leads to consideration of the problem of the farmer who uses an airplane and wishes to use it himself for such purposes. Current CAA recommendations for low flying far past control require that the applicant is using a capable and experienced pilot holding at least a commercial rating. Some state agricultural commissions are prescribing similar requirements.

► **Hazards**—Florida involved in low level flying for dusting, spraying and seeding are not to be regarded lightly. CAA records showed 165 aerial accidents in 1947 including 24 fatal accidents and 16 serious injury accidents. Yet there are many proficient farm flyers without commercial licenses who would be certified for this type of flying on their own farms and provision for them to do this flying without unnecessary regulatory hindrance will be needed if full growth of farm flying growth is to be realized.

Legal problems caused by damage to neighboring crops from dusting aerial spraying and darts, as being studied by CAA, state entomologists, the National Thrive, Farmers, Aerial, the Department of Agriculture, state agricultural colleges, and other groups. It is anticipated that legislative restrictions may be forthcoming from a number of the state legislatures, meeting this year on this subject. Efforts are being made individually and collectively by the state and federal agencies and the flying farmers to develop some standard and techniques and to determine more widely necessary legislation for most efficient use of aircraft in agriculture.



The Martin 404A biplane shown flying, left, "404A Model" by one of the jets.

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effort to get the appropriation made.
► Specific Project—Difference between the \$62,092,281 in grant funds, and the total of \$117.5 million appropriated in its money that has been already awarded for specific projects but which has not yet been finally obligated in grant funds.

Two factors are seen as causes for faster CAA action on airport funds in the past year: greater familiarization with the process to be accomplished, and some simplification of involved CAA procedures.

► Simplification—State aeronautics agencies and local sponsors can take credit for bringing about much of the simplification. Numerous heated conferences resulted in a "streamlining" last March in which some eight forms were eliminated, and in which the project application and the sponsor's estimate agreement were consolidated.

Supplementary airport aid programs developed by many of the state and aerial sponsors have also contributed materially to the sponsored status of airport financing and encouraged many local communities to apply for airport projects which they might not have been able to finance single-handed.

State funds have also been made available for numerous small airport projects which did not seek federal aid and these have contributed indirectly to the total number of airports.

State aviation guidelines have long been severely opposed by airlines and other operators of aircraft, not being used in some of the states to finance their airports, while other states make appropriations from general funds.

► Examples—Two hybrid state airport aid programs are those of a New England and a Western state.

Massachusetts reports allocation of \$676,750 from state funds to go with \$1,548,000 in federal funds toward a total airport expenditure of \$2,124,750. This will be used for design, construction and improvement of 12 municipal airports, the balance to be paid by local sponsors.

Utah has a 23 project airport pro-

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Piston for Martin P-40-1, with close-up view of grinding on the hardened steel.

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TRANSPORT



Transported—Berlin. (center) by the air. (bottom) administration building (foreground) by MATS' efforts.

Berlin Airlift: Transport Air Power in Action

From spectacular achievements has sprung hope that strategic transport will be built to first-class strength.

By Charles Adams

Military and commercial air transport, which were regarded as a Cinderella role by U. S. defense planners prior to the Russian blockade of Berlin, have assumed their rightful position in the headlines through the history-making achievements of "Operation Vittles."

The Berlin blockade simultaneously spotlighted the strength and limitations of U. S. strategic airlift capacity. Most important, it has given promise that some of the most daring transport units, never will be content and the danger of developing a first-class combat Air Force supported by an outstanding air transport will be eliminated.

► **MATS Takes Over**—Since the Military Air Transport Service lost less than a month after a one-way official contact through consideration of the Air Force's Air Transport Command and the Naval Air Transport Service. Naturally, MATS' duties involve supercharges (and often unappreciated) scheduled in-flight operations over established

routes. With the Berlin crisis, MATS overnight assumed its most important responsibility—strategic airlift. When Operation Vittles began last June, the small fleet of C-47s used by the USAF's European Air Transport Service and uncommitted RAF transport pool, over the airlift landing, but could feed only a trickle of supplies into Berlin. Now MATS has about 225 C-54s (and five Fairchild Proctors) in as well during the summer into the German capital. Seventy-five other aircraft are steadily passing through the main transport pipeline.

► **Weather No Obstacle**—Most significant is the fact that during most of the German winter there has been little or no action between weather and transport handled. Berlin's requirements of 4,500 tons of supplies daily are being met. MATS officials describe Operation Vittles as "the greatest air transport operation the world has yet seen."

During the first seven months of the blockade, U. S. aircraft used in Open Box Vittles flew 141,250,000 ton miles by comparison, U. S. certified domestic

freighters flew only about 116,418, 800 ton miles of freight, cargo and mail in all of 1948.

► **Stays on Resources**—But MATS has not achieved its success without strain, and at times has been close to faltering under the load. The airlift has involved a heavy drain on MATS' personnel and equipment. Requirements of Operation Vittles have made necessary extensive redeployment and curtailment of MATS' services on other parts of the world.

MATS states that a replacement and modernization program for its planes over the next five years is imperative. "Obsolescence of our C-54s is such that by July, 1952, the entire fleet will be composed of second line types," MATS has informed the Secretary of Defense.

► **Lange Plans Expansion**—Major Gen. Laurance S. Keller, MATS' commander, emphasizes that the delay of U. S. strategic airlift has in the development and production of big transports with these characteristics: Ease of maintenance, high utilization, direct loading and unloading, useful capacity of about 25 tons, range of 1000-1000 miles and low cost of operation.

Speed of the craft should be about 190 mph, according to Keller. But he cautions that "as this era of jet and



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emergency flight it is important not to transfer this emphasis on speed to the field of air transport, where it is a secondary consideration.

► **Air Force Orders Transporters.**—The Air Force has given its big transport planes through Air Force orders for the Douglas C-77 Stratoflighters and the Douglas C-124 in version of the C-74 Globemaster capable of handling bulk loads. The MATS commander has called for a unified effort by the industry, the airlines, the aircraft industry and the public to support development of a great national fleet of large transporters which will carry their way in a cohesive, contributing a piece to national prosperity and to national defense in time of emergency.

Without this expansion of the national merchant fleet, MATS would be helpless to provide the tremendous airlift which is now to be one of the first requirements of any major emergency, Kester declared.

► **Prototype Legislation.**—Congressmen have better legislation authorizing a large program to build up the U. S. fleet of cargo aircraft. Bills introduced recently by Sen. Edwin Johnson (D., Colo.), chairman of the Senate Interstate and Foreign Commerce Committee, and by Rep. John Kennedy (D., Mass.) would authorize the government to develop and purchase new cargo planes for leasing to the airlines. Rep. Landrum Beekman (D., Tex.) has offered a measure authorizing the government to spend up to \$50 million a year on financial aid for plane development.

On the Republican side, Sen. Owen Brewster and Rep. Carl Albert have introduced bills authorizing the government to pay prototype costs of new commercial transport and cargo aircraft. Senator John Chafee, Republican, introduced a measure in the Senate last week signed by the President's Air Policy Commission and the Congressional Aviation Policy Board were before the last Congress but did not receive Senate approval in the rush for adjournment.

► **Airlift Deficit Critical.**—Need for prototype legislation to build up the commercial cargo fleet is seen in MATS statement that its general strategic lift capacity is three-quarters of a billion man miles annually, equivalent to a requirement of seven and one-half billion annual man miles for a national emergency. If all civilian strategic aircraft (largely four engine types) were made available this would provide MATS with an additional lift of one and one-half billion man miles annually, making a total of two and one-quarter billion.

MATS estimates that the present lift left would be acquired for rapid support, leaving about two billion man miles to be applied to the annual requirement.

The result is a deficit in strategic airlift of five and one-half billion annual man miles.

► **Stratoflighters Purchased.**—Recognizing the situation on MATS' transport fleet as a result of Operation Vittles, the Air Force recently diverted money authorized for other purposes to permit purchase of 21 additional C-77A Stratoflighters. Boeing previously had a production order for 27 C-77s, making a total of 50 now on order by the USAF. The Air Force already has taken delivery on 10 service test YC-77s. Stratoflighters can carry a 45,000 lb. load and have a 500 mph cruising speed.

USAF also has 30 Douglas C-124s, capable of handling 50,000 lb., on order. The Air Force has taken delivery on 15 Douglas C-74 Globemasters, from which the C-124 design is derived. Twelve Globemasters have been ordered on trans-Atlantic runs in support of Operation Vittles but are not used as regular schedulers into Berlin.

MATS emphasizes that a tank liner made up of 66 C-74s, C-124s or C-77s could carry 4900 tons of supplies into Berlin daily. In contrast, it takes 178 C-54s carrying 70,000 lb. loads or 109 C-47s carrying 6800 lb. loads to do the same job. Bigger, faster aircraft mean impressive economies all along the line—fewer trips, flying lower, air crews, maintenance personnel and gallons of fuel and.

► **Airlift Reserve Inadequate.**—At present, the commercial airlines lack the large type cargo planes required to beef up MATS in case of a major emergency. Fortunately, MATS has not been forced to call on the airlines to turn out equipment for use in Operation Vittles although both certified and un-certificated carriers have done a number of trans-Atlantic trips under contract in support of the Berlin airlift.

As of Jan. 1, 1949, U. S. scheduled domestic and international airlines had only 104 cargo in combination cargo-passenger transports. Of these, 66 were four engine types—41 C-54s. The remainder were C-47s and C-46s.

Significantly, not one of the large new four-engine transports by MATS is on order by a commercial airline. A study of all four-engine civil aircraft on the Civil Aeronautics Administration's records shows the U. S. has about 275 new military C-54s or DC-4s, 109 DC-4s and 75 Constellations, plus an equivalent with such as Boeing Stratoflighters and Boeing 314 flying boats.

Two engine civil transporters usually considered too strategic by MATS, are plentiful. There are about 910 DC-3s alone.

► **Vittles Airlifters Technicians.**—But in fact fewer than 1000 men are left to contribute importantly to the growth of U. S. commercial air strength. A



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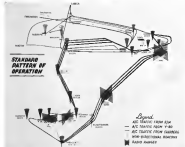
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Twenty-five tons of fuel was piled into the Douglas C-54 Glidermaster and loaded down preparatory to the flight along the air corridor into Westland Berlin. The C-54 carried the largest individual loads into the German capital and was especially valuable in carrying heavy motor building equipment into Berlin to be loaded in a C-54. But planes of this type are not used regularly in the Berlin corridor. Instead, they have been placed in service over the North Atlantic in support of "Operation Varsity".



Airbit traffic along the corridor to Berlin is shown in the chart of Operation Varsity. Courses of planes flying to and from the German capital have been in Western Germany as indicated together with the

Civil Aeronautics Board technical advisor, Col Robert V. Garrett, who recently made a first-hand study of Operation Varsity, reported he was particularly impressed by (1) The application

of new weapons and ranges used in aerial navigation and (2) the accuracy of the Rhein Main report and (3) the Westland field, both located in the American sector. Frankfurt is in the British sector.

tion of new methods of air traffic control; (2) the accuracy, but not value of flight engineers on their engine air craft; (3) flight crew confidence in and precision use of GCA radar leading to

equipment; and (4) proof that it is not only possible to control air traffic from the ground but also to control it from the air.

On the Berlin run, the USAF operates schedules over and over again with planes as close as three minutes apart and with 500 ft vertical separation. A method of air traffic control has been established which eliminates stacking of aircraft in a holding pattern while waiting clearance to land. This is a complete departure from the accepted method of air traffic control practiced in the U.S.

Each aircraft missing an approach to Berlin incurs a departure procedure and returns to its point of takeoff to be sent to intercept following flight schedule. But missed approaches are so few as to be of little consequence on the airlift, according to Col Garrett.

Flight Engineers Visible—V of the C-54 air crews on the Berlin run are composed of pilot, copilot and flight engineer. USAF believes that addition of a flight engineer allows the pilot to give his undivided attention to his instruments, thereby reducing an extra take-off climb, accurate approach and landings. Duties assigned to the flight engineers also include minor maintenance work in flight and control check up on the plane's mechanical condition before, during and after flight.

All of the C-54s are equipped with standardized flight instrument panels. Col Garrett noted that U.S. air crews and instrument panels have been able to agree on a standardized cockpit, as well as standardized flight instrument panel, for civil transports. While some progress in this direction has been made by airlines adopting a common standardized flight instrument panel, there is still no uniformity between airlines.

GCA Uses Spotlight—Ground control approach (GCA radar) is the standard instrument approach and landing system used on the airlift. The instrument landing system (ILS), which is the standardized instrument approach and landing system at most major U.S. airports, is not used on the Berlin operation.

GCA is used by the USAF on all low visibility approaches at the four air ports dispatching C-54s into Berlin and at the three airports receiving the planes inside the German capital. At times at times C-54s at one time are under GCA control in final approach.

Old Type Radar—The GCA installations at the seven airports are MFN-1s, or variations of that type. These are the oldest-type GCA units in use having been manufactured in 1945. Only six of these have had several thousand hours service without major overhaul. Three require four months of work at all times. A few two-month



How Glendale's Sky Roomers reduced engine maintenance cost 53%

Recently, the Sky Roomers Flying Club of Glendale, California, since the engine of their Continental 85 Powered Cessna 140 to the shop—after 1000 hours—found service without repair—for a checkup.

"It was still running quietly, had no stuck rings or valves and was using only one quart of RPM Aviation Oil in eight hours," is the surprising report of Mr. James H. Brown, secretary-treasurer of the club.

"Our previous Continental 85 engine, using two other aviation oils, took into three times in 700 hours. Engine maintenance cost was \$3.95 per hour."



Handling your brakes correctly?

When you use brakes excessively, without allowing them time to cool they may not hold when you need them in case of an emergency. It's a good idea to always test your brakes while driving before take off, and use them in little and to lightly is possible while driving. Even more important, inspect them regularly.

"We'll take better care of your plane"

AVIATION WEEK, February 23, 1949

A page of service tips for private flyers and fixed-base operators

ENGINE: CONTINENTAL 85-hp
OIL USED: RPM

Ring belt area free of deposits after 1000 hours

Ran four times longer than the longest run using other oils



—Prevention of stuck rings and valves gives maximum service at 1,248 per hr.

"Using RPM Aviation Oil, with no ring or valve jobs," concludes Mr. Brown, "reduced cost to \$2.48 per hour."

REMARKABLE, ISN'T IT? how the special detergent in "RPM" keeps belt areas free from deposits? And another compound in "RPM" makes it easy to hot tap the cylinder walls. Let him and exposed to wear by ordinary oils. Really, "RPM" often doubles the period between overhauls!



BUILT *to* LAST

NEW BENDIX-PACIFIC AN-6248-1 3000 PSI HYDRAULIC HAND PUMP



—a characteristic of all Bendix-Pacific hydraulic hand pumps—is an outstanding feature of the new Model 620100 (approved as AN-6248-1) for 3000 PSI systems. The pump weighs 1.55 pounds.

Thus dependable ½ cubic inch capacity pump materially exceeds AN construction requirements. The body is a permanent mold casting and the forged handle socket is designed to resist extreme side loads as well as high operating loads and to withstand the roughest usage in restricted cockpits.

A double-acting piston producing approximately equal volume on the in and out strokes and an integral suction check valve employing the proven

Bendix laminated phenolic poppet are additional features of the pump. These poppets give long service and can be replaced without logging or other pre-assembly operations. Pre-lubricated bearings provide lifetime wear-free operation. The pump is available with or without handle. Complete data gladly furnished to qualified companies.

THE FOLLOWING 3000 PSI PUMPS ARE NOW AVAILABLE:

| Bendix Assembly | Description |
|-----------------|------------------------------------|
| 620100 | AN 6248-1 |
| 620100-1 | AN 6248-1 except ½ inch port |
| 620110 | AN 6248-1 with tapered ½ inch port |
| 620120 | AN 6248-1 with 1 1/8" handle |



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EXPORT DIVISION: BENTIX INTERNATIONAL, 72 10TH AVE., NEW YORK 17, N. Y.

GCA unit (GPN 4) is being installed at Berlin's Tempelhof Field.

Besides two MPN 1 type GCA units in use at Tempelhof, a new type air surveillance radar unit (GPN 5), a more sensitive, early warning installation with moving target indicator, began operating during December, 1948. Located on top of the Tempelhof administration building, this new unit can control visible traffic within a 100-mile radius of the field.

The moving target indicator records only moving objects, thus eliminating stationary returns, known as ground clutter, which appear on the scope of older radar units. Range of the new unit permits it to be used for controlling aircraft into all four airports in Berlin.

MAT's Gen. Kuter states that GCA used in Operation Vittles is moving about five times as rapidly as ever before. He quoted Genant as saying that Operation Vittles has advanced the art of air traffic control by 30 years. USAF safety work on the Berlin airlift is even admirably better than the overall Air Force record.

Loading and unloading Operation Vittles C-54s is largely a manual affair performed by 12 to 15 skilled personnel supervised by USAF enlisted personnel. Work is arranged to insure that no plane spends more than 40 minutes on the ground.

► **Cycled.** Reconditioning—Master aircraft-wear, all 50 he checks on C-54s as performed in Germany, and 200 he checks in England. For the 1000 he overhauled, the plane is flown back to the U.S. C-54 situation on the airlift averages 34 hr daily.

MAT's had complete plans for re-tooling of cycle reconditioning of aircraft before Operation Vittles began. But the emergency has provided an unexpectedly good opportunity for giving this type of maintenance a thorough test.

Gen. Kuter says MAT's is already prepared that for best utilization of maintenance facilities, progressive overhaul definitely has the advantage over conventional preventive maintenance.

Planes In Use

While newer transport types increase, DC-3 is still the workhorse.

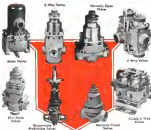
U. S. airlines are operating a record number of planes in scheduled domestic and foreign service.

At the beginning of 1949, carriers were using about 1961 aircraft for regular flight, compared to 971 a year before, CAA statistics show. Total at the start of 1949 were about 839.



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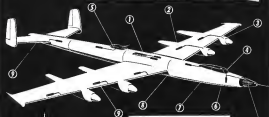
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| Manufacturer | Description | Capacity | Performance | Range | Dimensions |
|------------------------------------|---------------------------------|----------|--------------|--------------|--------------|
| Boeing Aircraft Co., Boeing, Wash. | Boeing 247-1 Boeing 247-2 | 10 10 | 1000 1000 | 1000 1000 | 1000 1000 |
| Boeing Aircraft Co., Boeing, Wash. | Boeing 247-3 Boeing 247-4 | 10 10 | 1000 1000 | 1000 1000 | 1000 1000 |
| Boeing Aircraft Co., Boeing, Wash. | Boeing 247-5 Boeing 247-6 | 10 10 | 1000 1000 | 1000 1000 | 1000 1000 |
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► **Workhorse 508 in Houston**—The DC-7's continued to be used even after other transport in scheduled service. Almost 470 of these workhorses were operated on regular domestic and international flights at the start of 1949. There were 513 in use a year before.

DC-4s in service declined from 244 at the beginning of 1948 to 246 at the start of the year. But newer transport types were appearing in greater numbers.

► **Newer Transports Increase**—About 100 DC-6s were being used on Jan. 1, 1949, against 86 a year before. Model 540 Constellation in service decreased from 18 to 13 in the 12-month period, but Model L-40 Constellation numbered 44 and Model 749 "Gold Fleet" Constellations increased from nine to 15.

No Convair-Learns were in scheduled service at the start of 1949, but 58 were in use at the beginning of the year. Martin 3-0-3s—all operated by Northwest Airlines—increased from nine to 24.

► **Fleet Composed**—Other planes in regular operation on Jan. 1, 1949, with the Jan. 1, 1948, totals in parentheses, are: Lockheed Lodestar, 12 (13); Lockheed 10A, 6 (none); Boeing Stearman, 5 (5); Stearman, 7 (7); Beech D-18C, 6 (6); Sikorsky S-41 helicopter, 5 (5); and Cessna C-46, 2 (none). The Lodestars are all operated by National Airlines; the Lockheed 10As by Wisconsin Central Airlines; the Boeing Stearmans by TWA; the Stearmans by All American Airlines as its primary route which will be replaced this year; the Beech D-18Cs by All American and Florida Airways; the Sikorsky S-41s by Los Angeles Airways; and the C-46s by National.

Boeing 347-8s left the strings in the past year. Empire Air Lines, a leader, had four during 1947.

► **Cargo Equipment Swept**—CAA reported that 184 all-cargo combination cargo-passenger planes were included among the 1081 transports in scheduled service Jan. 1, 1949. Of these, 18 were C-54As, 27 C-54Bs, 28 C-102s, 6 DC-3s, 17 DC-3As, 75 DC-3As, and 2 C-46As. Sixty-four of the planes were in service domestically, most of them exclusively in cargo work.

Of the 35 cargo and combination planes operated by U.S. airlines and international carriers, 35 belonged to Pan American Airways. Nine of PAA's aircraft in the cargo and combination category were fitted and exclusively for cargo according to the CAA's data. The entire Pan American fleet at its fleet 10 C-46 freighters leased from the Air Force.

Among the domestic operators, United Air Lines and American Airlines had the largest all-cargo fleets in scheduled service at the start of 1949. The UAL fleet included five C-54As, one

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men and officers. There are still loads enough to test any large number of young men away from the attitudes of civilian employment, now running at an altitude high. British war levels are double or more than that needed before the war.

In the case, this important expense is due to increased production that is put behind the aviation drive.

Town of this drive is that the RAF needs at least 100,000 new airplanes over the next two years to meet its regular strength to about 180,000 new and various. This means new airplanes at the rate of 300 a week, which the drive to date certainly has not begun to produce. However, this must certainly be the second time for the future RAF, even though nearly half of the war called up by the emergency National Service are choosing the RAF as their profession of the branches in which to serve.

► **British 100**—Waiting for military aircraft to start flying again, British aircraft and engine builders are being kept alive (and busy) by their export business and in a few cases their successful civil transport efforts.

Total production of planes (excluding military types) for the first 11 months of 1945 was only 421, compared to 770 in all of 1944 and 944 in 1945. Exports for the full year 1945 included 281 new planes (including military types) and conversions and sales of production types which brought the total to 3944 planes north 613.

Brazil: Aviation Goes Country

By Henry W. Boyer

RIO DE JANEIRO—Civil aviation marked the development of Brazil's vast coastline in 1944 and helped strengthen the country as an ally in its future economy.

With more regularly scheduled lines and several mechanized carriers operating, Brazil now has flying fields scattered almost over the entire of the country in the air.

Seven foreign companies also are running regularly to and from Brazil: Pan American, British South American, Aer Trans, Southwestern, KLM (PAMA/Agencia) and Terna (Spain).

► **Argentine**—In many cases, domestic airlines have built the airline or contributed substantially to their development. Many airports are going up steadily. One view of projected fields will make two-engine plane landings possible at several points between the country's developing coastal areas and the Amazon's mouth.

Brazil has moved from the home-and-hobby era in the air to more than

425,764. This compared to the preceding year's exports of 270 new planes and total exports of 1733 aircraft worth \$13,754,147.

Aero engine exports in 1944, 1945 only north \$1,707,524, were down slightly from 1947, when 3430 engines worth \$4,083,434 were shipped.

► **Aviation Goes**—All three of the scheduled airlines made new gains during 1944. British Overseas Airways Corp., largest of the three, flew 118,363 passenger miles, a total of 346,300,000 passenger miles, an increase of 32 percent over 1947. The Corporation also earned 3166 tons of freight an increase of 68 percent, and 1723 tons of mail, an increase of 8.8 percent. Service was in operation at the end of the year netted 130,600.

British European Airways flew 150,446,629 passenger miles in 1948 as an increase over 1947 of approximately one third. Freight (3642 metric tons) and mail (2334 metric tons) were nearly double the previous year. Total passenger miles flown were 12,345,369, advanced with slightly fewer planes.

British South American Airways flew 17,530 passenger miles, a total of 46,242,999 passenger miles in 1944, compared with 42,064,779 passenger miles in 1947 or double was this 18 percent increase and carried 751 tons of mail and freight compared with 645 tons in 1947. The carrier flew 6,173,476 passenger miles, an increase of 36 percent and its route miles as of Dec. 31 were 21,911 one way with 20,194 the year previous.

and increasing development of roads and highways. In some remote towns with airports, the only overland link with the outside world is by river or aerial route.

Only seven airports, however, are large enough for four-engine craft, and only nine are equipped for night flying. ► **Budgets**—The federal budget for 1949 totaled nearly \$75 million for the military, under whose wings come all military and aerial operations. This is an increase of about \$10 million over 1948.

The air force, made by North American standards but sharing with Agusta the top spot in South America was American equipment. Pilots who flew in a Russian fighter squadron as the Indian force and others who main tened a Soviet Atlantic patrol gave the air force some experience that others in South America.

National civil aviation companies flew about 183,000 hours in 1947, carrying 770,000 passengers and about 23,000 tons of freight and baggage. Figures for 1948 are not available.

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More progress in military aviation has been achieved in this country than in any other on such supplies of electronic components for military aircraft as develop with the changing pressure on fuel. The Scintilla Magneto Division, as Bureau producer of ignition equipment for military, commercial and personal aircraft, attributes much of its own growth and achievement to the basic incentive of keeping America first in the air.

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France Gives Up Hope Of Balanced Air Power

Manpower and production to be scaled down; jet work to continue.

By Boyd France

PARIS—The French aviation industry has pulled out of its long talisman and gone into a severe drive. Both quality and diversity of production will be cut back drastically in the first quarter of 1949.

About 17 factories are slated to be shut down completely. Others will scale down production schedules. The industry's manpower pool will be drained 30 percent to an approximate level of 160,000.

No Balance—At the same time France will give up attempts to support a full-sized air industry and will concentrate on light and medium sized types. Both military and civilian aircraft over about the 70-ton limit will be cancelled out before production schedules.

Some jet research will be continued. But most of the French Air Force's jets are expected to be foreign types manufactured in France under license. The French government has been deliberating for months with the British for the right to make Vampire. There are hints that it also is eyeing some U.S. jets.

The French Air Force and commercial aviation will reflect this scheduled cutback of industry. The Air Force already has liquidated its bomber squadrons, for example. Air France will have to continue lengthening its long-range planes.

It was inevitable that French aviation should take a nose-dive.

Planning—France had not had planning its postwar aviation program. Air power symbolized regained national unity and pride to the debilitated and humiliated French. They determined to have a big aviation air force and aviation industry regardless of whether or not France could afford it.

The lower level of the aviation industry consequently maintained to over 150,000 jobs in 1946. Between 1944 and 1946 During the same period U.S. and British air industries were being run wholesale.

Too Years Behind—The French showed the same enthusiasm in technical planning. French technicians were lagging about 10 years behind their American and British opposite number in experience. But they impatiently wanted catching up, copying French or U.S. planes. Instead they went off on a wild designing spree.

No less than 25 different prototypes

French Aircraft

PARIS—The following list of interesting French aircraft with brief editorial comments on each outlines the present difficulties of the French aviation industry.

Helicopters

- G-11E (Breguet)—No prototype. Poor in production.
- N-4700—Made one. Apparently abandoned.
- NC 3000—Made one. Rather good in flight and test crashed.
- SO-1000—One has flown but details of the flight are unreliable.
- SE-1001—Experimental and research also for advanced study. One has flown.
- SO-1100—Jet helicopter. Made two. One crashed and burned on test flight. Second is scheduled to be tested soon.

Military Aircraft

- Lefevre 310—Research plane. Landing gear tested in first test flight. Now being flight tested on back of a Langlois.
- Messerschmitt jet—Study design. No prototype made yet.
- Nard 5500—Experimental jet. Made one which hasn't flown yet.
- N 1501—Research jet. Made one which hasn't flown yet.
- N 1513—Transport. No performance data.
- N 2200—Nard jet fighter powered by a Nard engine. Still not completed.
- NC 270—Two jet bombers. Not finished.
- NC 271—Flying model of N270 being tested.
- NC 1000—Nard fighter.
- SE 1800—Jet propelled flying wing project.
- SE 2400—Jet bomber project.
- SE 2410—Fighter bomber.
- SE 4000—Jet fighter bomber.
- SO 4000 M2—Research flying model of SO 4000. Originally planned to be powered with Dervent V1 jet engine powered with Nard. Being tested on top of a Hispano 274.
- SO 6000—Jet.
- SO 6001—Production version of SO 6000. Made half a dozen of them.
- SO 6003—Jet fighter. Powered Nard. Looks like SO 6000 but badly designed. This flows over but no details available. (This SO 6000

never has received a lot of publicity, probably has too bugs in it that other French jets. But they are all conventional airplanes with no specially original or interesting features.)

- SO 6000—Cassini home jet propelled fighter.
- SO 610—Scaled down model of SO 4000.
- VU 10—Nard fighter. Two-engine, one front one rear. Must be forced landing first test flight because of over-speeding of rear engine.
- SO 7000—Light transport.
- NC 70—Jet fighter and transport. French plane with sharply swept back wings. Completed during 1948 flight.
- VU 98—Single seat sail fighter.
- Breguet 701—Cargo plane. Will be flown soon. Four are being built.
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- Breguet 989—Cargo plane. Will be flown soon. Four are being built.
- Breguet 990—Cargo plane. Will be flown soon. Four are being built.
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Dutch Air Power On Upswing

AMSTERDAM—Holland's expanding military program is getting heavy emphasis on air power, particularly under pressure of the western countries, union.

Actual strength of Netherlands' air force is unknown, but Hansaard, Tiger, Moth, Spitfire, Oxford, Meteor and Sea King are all current operational types. To date, all have been reported for Dutch manufacturing is taking an upswing.

Learner Production—Fokker, leading Dutch aircraft producer, is undertaking license production of the Gloster Meteor and the Hawker Sea Fury for the Netherlands and Belgium aircraft and wing air forces, at its new factory near Amsterdam. Meanwhile, Holland's first operational Gloster Meteor squadron has been established.

Fokker's production is centered around three types:

• **F-25 Protonator**—A postwar-developed four place touring aircraft, the Protonator is a single engine pusher type low wing monoplane. Series of 10 are nearing completion. Craft is powered by a 24-cylinder 6-435-A engine and has maximum speed of 140 mph.

• **S-11 Instructor**—Series of 100 of this type is under construction. Craft is a single-engine two place tractor, powered with a Lycoming 6-435-A engine. Maximum speed is 135 mph.

• **S-12**—This craft is similar to the S-11, except it is equipped with a nose wheel instead of the conventional type of landing gear. Prototype is complete.

• **S-13**—Prototype of the two-engine crew trainer is being developed and should be ready by the middle of the year. Powered by two Pratt & Whitney S3H1 engines, craft will have an estimated maximum speed of 212 mph.

• **S-14**—This will be a three-place jet trainer. Prototype is under development.

Conversions—Fokker's Amsterdam factory, and a smaller factory at Papendrecht, are converting Delftair and Sky master into jet-powered aircraft for 15 air force companies. One hundred aircraft are involved. The company, which employs 2400 persons, is doing all in pair and maintenance of military and naval aircraft for the Dutch and partly for the Belgian and Swiss air forces.

Aviation—KLM (Royal Dutch Air Line) is the Netherlands' chosen carrier. It covers over 100,000 kilometers, serving 40 different countries. KLM's fleet consists of 37 DC-3s, 11 C-47s, 4 DC-6s, 6 DC-66s, 5 L-49s, 12 L-749s, 7 Convair 440s and 2 Aviatik P-12. DC is in the European sector will gradually be replaced by Convair 440s.

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Sweden's Air Power Is Potential

It has all facilities for production, but finding funds to divert from economic recovery is problem.

By G. Howard Smith

STOCKHOLM—Sweden has found people in the whole country than in the city of New York, but its air arm is meager. Today's fighter force is about as big as the one which stopped the Nazis in the battle of Britain.

The question is, can the Swedish air force fulfill its function? It is the only one in Scandinavia, and its function must be to help the ground forces hold off attack long enough for Western aid to be effective when it comes.

Everything depends on whether the Russians want to start a war. If they should do it in the next year, then the outlook for Scandinavia would be bleak. Swedish military experts calculate that the Russians could land as many fighters in the air over Swedish territory as Sweden has altogether.

► Different Situation.—At a later date, the situation might be different—of depending on the quantities and types of planes the Western powers are able (and willing) to supply Scandinavia. Norway is beginning to build up an air force with British Spitfires and Mustangs, but Denmark has not even got over the starting line. Denmark's difficulties in placing orders suggest that the country is not regarded as a good bet from the military viewpoint.

► Far from quiet from the disbanding of modern forces and not doing as the latest fashions of American requests, Sweden does have all the facilities for airplane production. The country has a highly developed metal working industry, skilled workmen, and a considerable crop of highly trained engineers.

At the moment Sweden is facing the disavowal of all European requests trying to stretch their economic budget and means at the same time. It is not just the question of going to better. A small country's resources are limited,

and even Sweden's meager deposits on the account of the export drive.

For this reason, an hour expenditure dictated by military needs has been left hanging in next year's budget (1949-50). Compared with the current year, allowances have been cut 15 million kroner to 110 million. That is the amount personnel needed for payments, but the air force is authorized to place orders for another 100 million kroner.

► Strength.—Total costs for the seven-year program, which includes the 50 percent increase in fighter strength and raising the number of planes in such wing from 45 to 70, is estimated at close to 1.1 billion kroner.

Included in the equipment of the 80 existing day fighter wing are 140 Mustangs, 70 Vampire Mk. I, and an increased number of Swedish J21s (lock prop and jet propelled). They make a total of 500-600 planes. In addition there are six jets, and in process of delivery, 120 Vampire Mk. II, 78 of the latest new Spitfires (the reconnaissance), and 45 Mustangs for a new night fighter wing.

► Attack Wings.—One of the jet-fitted attack wings is equipped with pagetons J21, the other five with Swedish two-engine and single engine light bombers. Good purpose of these wings is to gain in ground operations.

The SAAB Argonave Co. is in process engaged in production of jet-propelled J21s and a jet working on the prototype of the J29. Shipping up of the production rate of Sweden passenger jet and multi-engine fighters since Swedish ABA has been ordered only 10.

De Havilland Golden II brings engines are being manufactured on license by Svenska Flygmotor AB—like Swedish version being called Golden III. De Havilland Golden engines are to be produced shortly by this company.

Canada's Value as U. S. Ally

TORONTO—Canada's steel aviation production may be in competition with American auto factories of private and transport craft, but Canadian military aid power, in any way emergency, probably would be coordinated with American aid to form a North American Bloc.

In the light of that, here's what Canada could contribute now:

The Royal Canadian Air Force on the

past calendar year has received more power from 11,600 offices and over to 14,000. Power used has been directed to Canada.

► A search and rescue service which is in use at least once a week in some part of Canada.

► Development of a transport command, which last year flew 113,000 hours, at compared to 54,000 hours in 1947.

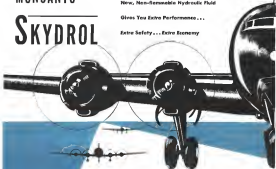
► Aerial photography of 911,000

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squad scales by two photo survey squadrons.

• **Establishment of the first two jet-powered amphibious squadrons**
• **Jet Squadron-RCAP** now has 10 jet-powered amphibious squadrons, all equipped with Vampires jet fighters. A new photography squadron of eight Lancaster aircraft is to be formed this summer, with some of the planes equipped to use SIGRAN.

The RCAP budget estimate for the current fiscal year ending May 31, 1964, is \$58,130,000 as the fiscal year 1967-68.

• **Other Estimates**—Other budget estimates: Navy, \$10 million; Army, \$10 million; defense research (including aerospace), \$16 million.

Much of the air research has been spent on development of a new concept jet fighter at the Malton plant of A. V. Roe Canada Ltd.

Royal Canadian Navy air arm consists of British Fleet Air Arm (FV) and VFA, or the aircraft carrier HMCS Magadenta.

• **Manufacturing**—Canadian aircraft manufacturing is mainly in the Toronto and Montreal areas. At Toronto, A. V. Roe Canada Ltd. is working on a jet fighter for the RCAP, and is completing the prototype of a jet-powered commercial transport. It has also developed the first jet-powered Chevrolet engine.

De Havilland Aircraft of Canada, Ltd., Toronto, is building Chequamegon trainers for RCAP and Beaver single engine transports for provincial government and commercial agencies.

• **Manufacturing Montreal**, Canada Ltd., is working principally on their version of the DC-4, powered with British Rolls Royce Merlin engines. Canadian has orders from Trans-Canada Airlines, Canadian Pacific Airlines, RCAP and BOAC.

Canadian Car and Foundry Ltd., Montreal, is modernizing North American Bellview trainers for the RCAP and FVFA aircraft for the Navy, as well as manufacturing Norseman single-engine transports. It is also designing a new Bombardier land-based, a model of which is now undergoing wind tunnel tests in Ottawa.

• **Purchases**—Last year, the RCAP bought aircraft in U.S. and Canada valued at \$7,900,000 and appropriated \$10,177,000 for modernization of 359 aircraft. Many trainers and bombers, including Canadian-built Lancasters and Lincolns, are in storage at Canadian aircraft plants, surplus from World War II. Meanwhile, RCAP types of planes in use are known to include Canso amphibious, Norseman, DC-4 (Douglas), DC-3 (North Star), jet-powered Vampires fighters, and a number of other

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Canada has started paying air training, with a government bonus of \$100 to the club training each pilot who passes her test, \$100 to the trainer on completion of his training, and a further \$100 if the trainee joins RCAP or RCASL member.

► **Foreign Orders**—FIAT has an order from Argentina for 45 G-55s for training fighters and 70 G-40s for aviation schools. Brazil has also ordered 19

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SE-3000 (France) (INE Photo)



Sukh 99 (Sweden)

The Birdmen's Perch

By Major Al Williams, ALIAS, "TATTERED WING TIPS,"
Gulf Aviation Products Manager, Gulf Bldg., Pittsburgh 30, Pa.

We're going to tell you right now because there are some mighty important addresses in Gulfgrade Aviation Series D, the great new Gulfgrade Old Gas Incidentally opposed search engines.

Well, as, when the staff starts really RPMing, it gives the old bird shaking the bearings a way rough time, indeed!

Four folks were in to us and asked for a picture of an old F4E. Ex-server pilots who'd been in demonstrator aircraft in the old Gulfhawk during the war.

"They said that the man is a pretty sweet type of character. And could they please have pictures of him."

"Pardon? Heck, said positively just our right now to appear who says new things about that really little creature they don't risk a signum, as we said, 400 pictures in fact, we saw ten pictures of the old Gulfhawk, the F4E and the new one (1957) Auro pagant sin too."

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Anyhow, we ordered up a stack of pictures of the two Gulfhawks which we'll send to you as long as the supply holds out. Meanwhile it is 10 photos more than we and we agreed every one of them!

But we have where no need clean, and they in point! (And you might need to see a Little Kitten Race, if you're extra bright!)

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And when you remember how it helps to stretch, relax and keep your car clean, how it increases your horsepower, how it keeps engine sounds clean, why that Gulfgrade-Aviation Series D adds up to a lot of extra lubrication value, doesn't it?

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CLEAN CLEANLINESS AVOIDS AS MUCH MAINTENANCE TRUBLE AS OILING

The Birdmen's Perch

By Major Al Williams, ALIAS, "TATTERED WING TIPS,"
Gulf Aviation Products Manager, Gulf Bldg., Pittsburgh 30, Pa.

We're going to tell you right now because there are some mighty important addresses in Gulfgrade Aviation Series D, the great new Gulfgrade Old Gas Incidentally opposed search engines.

Well, as, when the staff starts really RPMing, it gives the old bird shaking the bearings a way rough time, indeed!

Four folks were in to us and asked for a picture of an old F4E. Ex-server pilots who'd been in demonstrator aircraft in the old Gulfhawk during the war.

"They said that the man is a pretty sweet type of character. And could they please have pictures of him."

"Pardon? Heck, said positively just our right now to appear who says new things about that really little creature they don't risk a signum, as we said, 400 pictures in fact, we saw ten pictures of the old Gulfhawk, the F4E and the new one (1957) Auro pagant sin too."

Then we got to wondering if any of your First Places had the same collection for those ten birds that we do.

Anyhow, we ordered up a stack of pictures of the two Gulfhawks which we'll send to you as long as the supply holds out. Meanwhile it is 10 photos more than we and we agreed every one of them!

But we have where no need clean, and they in point! (And you might need to see a Little Kitten Race, if you're extra bright!)

They're here and the address is at the top of the page.

GETTING YOUR REAR END
Know what an address is?

And when you remember how it helps to stretch, relax and keep your car clean, how it increases your horsepower, how it keeps engine sounds clean, why that Gulfgrade-Aviation Series D adds up to a lot of extra lubrication value, doesn't it?

Dinner eat, for it!

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FORECAST

In 1949.....

Revenue Will Be:

Airline.....\$635,000,000

Manufacturing.....\$1,400,000,000

Deliveries Will Be:

Transport Planes—155

Two-place Planes.....2,400

Military Planes.....3,000

Four-place Planes.....3,600

Aviation Revenue to Top \$2 Billion This Year

This means operating profit for manufacturers, gain for airlines, and personal sales maintaining level.

In 1949 the manufacturing side of aviation will turn in an operating profit and an industry-wide net profit except where adjustments are made for tax purposes.

The airlines, anticipating that the Civil Aeronautics Board's final rates for 1948 will give them a profit for that year, expect to repeat in 1949.

The personal aircraft segment of the industry will at least hold its own, probably pick up a little in business, especially in the small airplane market.

The commercial helicopter, "coming" for five years, should at least double its 1948 sales and begin to be as profitable as it is useful.

These conclusions are reached after studying the state of national Aeronautics Week assembled for this issue. But forecasting the level of aviation activity this year is more difficult than at any time since the war.

The aviation industry is divided roughly into three categories: manufacturing (airframe, engine, propeller, accessories), transport (airline, contract

aircraft, military contract), and civil flying (business, recreational, personal and business flying). Here are the factors that must be considered:

► **Manufacturing**—The total net going into this part of the industry from private sources will be less than \$750 million. The remainder will come from the government, and the greatest part from the Air Force and Navy.

Payments from these sources bear no relation to shipments and sales, but in a sense of the value of airplane weight per pound, not in worker productivity.

► **Transport**—The scheduled airline industry is undergoing a two-stage revolution. Preliminary lines, whether classed as "coach," or "family plan," or "boarding discount," or whatever, are leading ahead at annual rates of gauging the industry's revenue level. Second the certified carrier's cargo

business now has begun modernizing. As for the remainder of this segment of aviation—contract and singular aircraft—there are statistics on record of the huge companies, but some industry-wide.

► **Civil Flying**—This is aviation's dark cloud, where a tremendous amount of flying is done each year, but little of it tends to be reported to any official or industry group. The Civil Aeronautics Administration has assembled some data, but the use of personal aircraft in business, for one example, is growing so fast that CAA's reports often lack help in forecasting.

Considering these factors, here's the way aviation looks in 1949:

USAF-Navy: \$5.5 Billion

The way the government's fiscal 1949 budget (for the year beginning July 1, 1949) now is set up, the Air Force and Navy Bureau of Aeronautics will have \$5.5 billion for procurement at several and related items in the next three years. There is little likelihood of the present request being decreased, even after the end of being considered.

More than half of that \$5.5 billion

Aircraft Employment and Forecast*

| | July 1948 | December 1948 | June 1949 |
|----------|-----------|---------------|-----------|
| Total | 1,615,380 | 1,227,380 | 244,000 |
| Boeing | 45,100 | 45,100 | 45,100 |
| Curtis | 45,200 | 45,200 | 45,200 |
| Lockheed | 45,300 | 45,300 | 45,300 |
| Northrop | 45,400 | 45,400 | 45,400 |
| Republic | 45,500 | 45,500 | 45,500 |
| Grumman | 45,600 | 45,600 | 45,600 |
| Waco | 45,700 | 45,700 | 45,700 |
| Stearman | 45,800 | 45,800 | 45,800 |
| Wiley | 45,900 | 45,900 | 45,900 |
| Wiley | 46,000 | 46,000 | 46,000 |
| Wiley | 46,100 | 46,100 | 46,100 |
| Wiley | 46,200 | 46,200 | 46,200 |
| Wiley | 46,300 | 46,300 | 46,300 |
| Wiley | 46,400 | 46,400 | 46,400 |
| Wiley | 46,500 | 46,500 | 46,500 |
| Wiley | 46,600 | 46,600 | 46,600 |
| Wiley | 46,700 | 46,700 | 46,700 |
| Wiley | 46,800 | 46,800 | 46,800 |
| Wiley | 46,900 | 46,900 | 46,900 |
| Wiley | 47,000 | 47,000 | 47,000 |

*Total plant employment based on reports to U. S. Employment Service from plants employing 200 or more and averaging at least 50 percent of its production in aircraft (airframe, engines and major parts, propellers and propeller parts and other parts). *San Francisco and San Diego, California and San Diego, California and San Diego, California.

slightly is appropriated, either in cash or interest—\$1.2 billion not yet having been paid out. Danger of any of this money being provided at all, that could happen if the national situation (airline) were stabilized on terms favorable to the U. S. and if a major business depression in this country made funds necessary for other purposes. It could happen if one or the other of these things occurred.

Military shipments in 1948 totaled 24,000 planes of \$2,143,500,000 value. In payments to military aircraft companies totaled about \$500 million.

Forecast for 1949: 3000 planes, of \$5 million airframe in, and payments to military aircraft manufacturers of \$1 billion.

\$1.4 Billion Gross

The \$1.4 billion that the industry already has available practically guarantees a large segment of aviation manufacturing a profit for the next two years. The year total payments to manufacturers—in airplanes and engines—from the military and from airlines and civil planes—should be about \$1.4 billion.

The level of present work should be right to support a work force of 244,000, estimated for June of 1949. Payments aggregating that total could leave the manufacturers with somewhere around \$100 million in operating profits. That statement, however, is subject to the qualifications that partial payments sometimes are not earned as often until all deliveries are made.

There may be no relation to expected deliveries. Government month after month payments, not payments for goods, airplanes or engines. The price manufacturers seldom know what the

price in delivered is costing the government because of the government's market experience (GFR) just for delivery by the government.

For that reason, the backlog is reported by prime contractors (page 23) also bear no relation to the work which the Air Force and Navy has in available for its own use.

► **Commercial Business**—Only a small part of the total 1949 payments will come from commercial transports. In 1949 transport plane deliveries were

| No. | No. | Value |
|----------|-----|--------------|
| Boeing | 15 | \$2,495,155 |
| Curtis | 14 | 1,994,000 |
| Lockheed | 14 | 1,994,000 |
| Northrop | 15 | 5,981,800 |
| Republic | 15 | 13,075,158 |
| Grumman | 15 | 13,060,404 |
| Waco | 17 | 6,073,711 |
| Stearman | 16 | 5,984,627 |
| Wiley | 16 | 6,711,101 |
| Wiley | 21 | 6,197,121 |
| Wiley | 21 | 5,495,161 |
| Wiley | 16 | 6,337,745 |
| Total | 203 | \$61,551,140 |

Source: Bureau of Census

Forecast for 1949: 155 planes valued (with spares) at \$120 million.

Among these planes should be all 55 of Boeing Airplane Co.'s Stratofreighters and about 70 General Lucards.

Deliveries on this scale will leave the major transport manufacturers with nearly clean books as far as commercial business is concerned. But all from Boeing, Douglas, Lockheed and Convair, will be turning out military versions of their transports.

► **Personal Planes**—Manufacturers of personal aircraft this year should be in a chosen spot for first-time experience as held. For the first time since 1946

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Authorized major engine overhaul for
Pratt & Whitney 9 H-6 L-60-

8-1020-8-2000 and 8-2000 series engines

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The fact that foreign airlines are increasing their share of air travel across the North Atlantic will demonstrate the CAB hearings on the proposed purchase of American Overseas Airlines by Pan American Airways. The decision in 1999 on that case will shape the future of Atlantic air travel.

Helicopters: Sales Peak

As far as can be determined, 1947 was the best year to date for commercial helicopter sales, with between 125-150 delivered by the only two manufacturers, Bell and Sikorsky, with articulated mainframes. Now another firm has received a certificate for a helicopter. Less than 100 helicopters were delivered in 1948.

Forecast for 1989: 150-175 helicopters delivered.

As pointed out on page 181 by L. Walsh Fogac, the helicopter has proved its ability. Until this year it has not proved its salesability. The reason has been cost—both purchase price and operating expense.

The favorable sign in the helicopter industry for 1949 is that prices are being lowered. United Helicopters on the West Coast—the third company to receive a certificate for a helicopter—has gone into production of a two-place submini model selling for \$19,995. UHJ proposes to manufacture 100 helicopters this year and next. It believes it can see a market for at least that number.

A perhaps more significant development is Bell Aircraft's pricing of a new model at \$21,388—after having raised the price of a similar machine from \$25,000 to \$39,500. Bell, the first company to receive a helicopter certificate, has been a leading producer.

A fourth company, Kaman Aircraft, will receive a certificate this year as an industrial helicopter which will sell for \$10,000 or less. This company claims it already has an eight 90 sales for this year.

The amount of helicopter development activity (last, page 102), in view of the poor sales records to date, is amazing. In 1949 the versatile machine will go on the market priced to stir up volume. Because of that, helicopter sales in 1949 could tell the future of commercial helicopter development.

If the optimism of the three existing producers, plus Korea, is well founded, helicopter development will expand. If not, the list of helicopters next year will be smaller.—W.K.

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[illegible]**POSITION VACANT**

POSSIBLE VANDALISM—A group of about 50 persons gathered last night in the city square and started to throw stones and other objects at the police. The police fired tear gas and water to disperse the crowd. The crowd was dispersed after about 10 minutes. A police officer was injured.

2000年12月15日

While unemployment has improved, the average monthly household income is still less than one-third of the U.S. level, and working conditions, particularly for women and youth, are poorer than in developed countries. By 2010, American banks,

and light, and with low, rolling dunes, as H. Davies characteristically no mountain or high ridge formations. The level this water is stored. More exposed to sunlight, the vegetation is a low, spreading shrub in the dune areas.

(Continued on page 23)



fourteen ways of looking at an engine...

Normally only four of the fourteen cylinders of a Pratt & Whitney R-1830-92 engine are checked for temperature during the test run. The four cylinders chosen for this check vary from shop to shop according to the findings of shop personnel. However, in all cases only those cylinders chosen for check are positively guaranteed against defect, while any unchecked cylinder in the engine may be developing a temperature symptomatic of a latent engine failure. For this reason a specially designed fourteen-cylinder thermocouple installation has been made on the Steward-Davis test cell, and the temperature of every cylinder must fall within Pratt & Whitney specifications before the Steward Davis R-1830-92 conversion is released for service.

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THE STEWARD-GIRTS & LEO-12 CORPORATION 8888888 AND YOUR RUN-OUT ENGINE, RUN-OUT ENGINE FREIGHT PRICED BY STEWARD DAVIS

Editorial Index

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AMERICAN INDUSTRY 100—Article 10, book 2, number of women employed in manufacturing, 1969-70, 1970-71, 1971-72, 1972-73, 1973-74, 1974-75, 1975-76, 1976-77, 1977-78, 1978-79, 1979-80, 1980-81, 1981-82, 1982-83, 1983-84, 1984-85, 1985-86, 1986-87, 1987-88, 1988-89, 1989-90, 1990-91, 1991-92, 1992-93, 1993-94, 1994-95, 1995-96, 1996-97, 1997-98, 1998-99, 1999-00, 2000-01, 2001-02, 2002-03, 2003-04, 2004-05, 2005-06, 2006-07, 2007-08, 2008-09, 2009-10, 2010-11, 2011-12, 2012-13, 2013-14, 2014-15, 2015-16, 2016-17, 2017-18, 2018-19, 2019-20, 2020-21, 2021-22, 2022-23, 2023-24, 2024-25, 2025-26, 2026-27, 2027-28, 2028-29, 2029-30, 2030-31, 2031-32, 2032-33, 2033-34, 2034-35, 2035-36, 2036-37, 2037-38, 2038-39, 2039-40, 2040-41, 2041-42, 2042-43, 2043-44, 2044-45, 2045-46, 2046-47, 2047-48, 2048-49, 2049-50, 2050-51, 2051-52, 2052-53, 2053-54, 2054-55, 2055-56, 2056-57, 2057-58, 2058-59, 2059-60, 2060-61, 2061-62, 2062-63, 2063-64, 2064-65, 2065-66, 2066-67, 2067-68, 2068-69, 2069-70, 2070-71, 2071-72, 2072-73, 2073-74, 2074-75, 2075-76, 2076-77, 2077-78, 2078-79, 2079-80, 2080-81, 2081-82, 2082-83, 2083-84, 2084-85, 2085-86, 2086-87, 2087-88, 2088-89, 2089-90, 2090-91, 2091-92, 2092-93, 2093-94, 2094-95, 2095-96, 2096-97, 2097-98, 2098-99, 2099-00, 2100-01, 2101-02, 2102-03, 2103-04, 2104-05, 2105-06, 2106-07, 2107-08, 2108-09, 2109-10, 2110-11, 2111-12, 2112-13, 2113-14, 2114-15, 2115-16, 2116-17, 2117-18, 2118-19, 2119-20, 2120-21, 2121-22, 2122-23, 2123-24, 2124-25, 2125-26, 2126-27, 2127-28, 2128-29, 2129-30, 2130-31, 2131-32, 2132-33, 2133-34, 2134-35, 2135-36, 2136-37, 2137-38, 2138-39, 2139-40, 2140-41, 2141-42, 2142-43, 2143-44, 2144-45, 2145-46, 2146-47, 2147-48, 2148-49, 2149-50, 2150-51, 2151-52, 2152-53, 2153-54, 2154-55, 2155-56, 2156-57, 2157-58, 2158-59, 2159-60, 2160-61, 2161-62, 2162-63, 2163-64, 2164-65, 2165-66, 2166-67, 2167-68, 2168-69, 2169-70, 2170-71, 2171-72, 2172-73, 2173-74, 2174-75, 2175-76, 2176-77, 2177-78, 2178-79, 2179-80, 2180-81, 2181-82, 2182-83, 2183-84, 2184-85, 2185-86, 2186-87, 2187-88, 2188-89, 2189-90, 2190-91, 2191-92, 2192-93, 2193-94, 2194-95, 2195-96, 2196-97, 2197-98, 2198-99, 2199-00, 2200-01, 2201-02, 2202-03, 2203-04, 2204-05, 2205-06, 2206-07, 2207-08, 2208-09, 2209-10, 2210-11, 2211-12, 2212-13, 2213-14, 2214-15, 2215-16, 2216-17, 2217-18, 2218-19, 2219-20, 2220-21, 2221-22, 2222-23, 2223-24, 2224-25, 2225-26, 2226-27, 2227-28, 2228-29, 2229-30, 2230-31, 2231-32, 2232-33, 2233-34, 2234-35, 2235-36, 2236-37, 2237-38, 2238-39, 2239-40, 2240-41, 2241-42, 2242-43, 2243-44, 2244-45, 2245-46, 2246-47, 2247-48, 2248-49, 2249-50, 2250-51, 2251-52, 2252-53, 2253-54, 2254-55, 2255-56, 2256-57, 2257-58, 2258-59, 2259-60, 2260-61, 2261-62, 2262-63, 2263-64, 2264-65, 2265-66, 2266-67, 2267-68, 2268-69, 2269-70, 2270-71, 2271-72, 2272-73, 2273-74, 2274-75, 2275-76, 2276-77, 2277-78, 2278-79, 2279-80, 2280-81, 2281-82, 2282-83, 2283-84, 2284-85, 2285-86, 2286-87, 2287-88, 2288-89, 2289-90, 2290-91, 2291-92, 2292-93, 2293-94, 2294-95, 2295-96, 2296-97, 2297-98, 2298-99, 2299-00, 2300-01, 2301-02, 2302-03, 2303-04, 2304-05, 2305-06, 2306-07, 2307-08, 2308-09, 2309-10, 2310-11, 2311-12, 2312-13, 2313-14, 2314-15, 2315-16, 2316-17, 2317-18, 2318-19, 2319-20, 2320-21, 2321-22, 2322-23, 2323-24, 2324-25, 2325-26, 2326-27, 2327-28, 2328-29, 2329-30, 2330-31, 2331-32, 2332-33, 2333-34, 2334-35, 2335-36, 2336-37, 2337-38, 2338-39, 2339-40, 2340-41, 2341-42, 2342-43, 2343-44, 2344-45, 2345-46, 2346-47, 2347-48, 2348-49, 2349-50, 2350-51, 2351-52, 2352-53, 2353-54, 2354-55, 2355-56, 2356-57, 2357-58, 2358-59, 2359-60, 2360-61, 2361-62, 2362-63, 2363-64, 2364-65, 2365-66, 2366-67, 2367-68, 2368-69, 2369-70, 2370-71, 2371-72, 2372-73, 2373-74, 2374-75, 2375-76, 2376-77, 2377-78, 2378-79, 2379-80, 2380-81, 2381-82, 2382-83, 2383-84, 2384-85, 2385-86, 2386-87, 2387-88, 2388-89, 2389-90, 2390-91, 2391-92, 2392-93, 2393-94, 2394-95, 2395-96, 2396-97, 2397-98, 2398-99, 2399-00, 2400-01, 2401-02, 2402-03, 2403-04, 2404-05, 2405-06, 2406-07, 2407-08, 2408-09, 2409-10, 2410-11, 2411-12, 2412-13, 2413-14, 2414-15, 2415-16, 2416-17, 2417-18, 2418-19, 2419-20, 24

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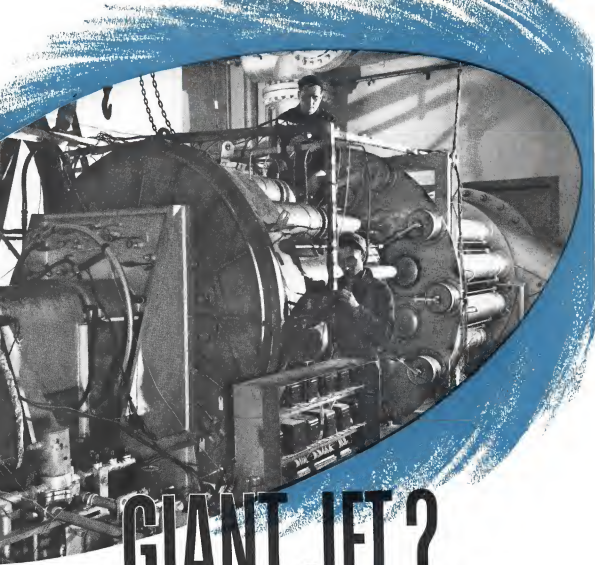
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